VOLUME 2 OF 2

MECHANICAL AND ELECTRICAL

CONSTRUCTION CONTRACT NO. 2
CENTRALIZED WASTE STORAGE AND TRANSFER FACILITY
PRATT & WHITNEY
EAST HARTFORD, CT

Specification Book No. M-572

MAY 17, 1991

Prepared for:

UNITED TECHNOLOGIES CORPORATION
PRATT & WHITNEY
400 Main Street
East Hartford, Connecticut 06108

Prepared by:

LOUREIRO ENGINEERING ASSOCIATES
100 Northwest Drive
Plainville, Connecticut 06062
(203) 747-6181

Comm. No. 971-13

ADDENDUM NO. 1
FOR
CONSTRUCTION CONTRACT NO. 2
CENTRALIZED WASTE STORAGE
AND TRANSFER FACILITY
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LOUREIRO ENGINEERING ASSOCIATES
100 Northwest Drive
Plainville, CT 06062
(203) 747-6181
Comm. No. 971-13

C.J. LAWLER ASSOCIATES
7 South Main Street
West Hartford, Connecticut 06107
(203) 233-8526

JAMES K. GRANT ASSOCIATES
2074 Park Street
Hartford, Connecticut 06106
(203) 236-5236

ADDENDUM NO. 1 CONSISTS OF THE FOLLOWING:

A. Five text pages including this cover page.
B. One new sheet to be included with drawings:
   Sheet E-6 of Drawing No. FS-030507-E titled "Wiring Diagrams"
   and dated 5-17-91.
C. Two sketches showing changes to drawing sheets:
   No. S-4-1 and No. E-1-1

A. CHANGES TO SPECIFICATION BOOK NO. M-572

DIVISION 0 - BIDDING REQUIREMENTS, CONTRACT FORMS, AND CONDITIONS OF THE CONTRACT

Section 00851 - Drawings Index

On Page 00851-2 add under Electrical:
"E-6 Wiring Diagrams"

DIVISION 1 AND 2: No Changes

DIVISION 3 - CONCRETE

Section 03300 - Cast-In-Place Concrete

On Page 03300-4, add a Paragraph 2.01 P to read:
"P. Curing, sealing and dust proofing compound for mechanical and electrical room slabs shall be Cure 309 by Sonneburn Building Products, or equal, applied in accordance with manufacturers instructions".

DIVISION 4 TO 7: No Changes

DIVISION 8 - DOORS AND WINDOWS

Section 08700 - Finish Hardware

On Page 08700-5, change Paragraph 2.06 B to read:

"B. Parallel Closer: Russwin T2810 B-4 for the following doors: 1, 2, 3, 5, 6, 27, 29, 33, 32, 37, 44 and 28".

DIVISION 9 TO 14: No Changes

DIVISION 15 - MECHANICAL

Section 25600 - Heating and Ventilating

On Page 15600-4, change the third sub-paragraph of Paragraph 2.03 to read:

"Exhaust fans EF-3A, 3B, 4A and 4B, in Rooms 6 and 7, shall be Series 35 with fiberglass housing and resin coated propeller (EF-4A shall be provided with special lining for resistance to dilute hydrofluoric acid vapors). Shafts and other metal parts in contact with the air stream shall be Type 304 Stainless Steel (except EF-4A which shall be monel)".

A. CHANGES TO SPECIFICATION BOOK NO. M-572 (CONT'D)

DIVISION 16 - ELECTRICAL

Section 16400 - Electrical Work

On Page 16400-3 add a new Paragraph 1.09 to read:
"1.09 Temporary Power and Telephone

"Electrical Contractor shall furnish and install a 480 volt, 3 pole, 100 amp circuit breaker in an existing Square"D", I-line circuit breaker panelboard located in existing barrel storage building, north of construction site, and run 100 amp, 480 volt service to new temporary construction power distribution panel opposite north-west corner of construction site about 250 feet west of the barrel storage building. Service to consist of 3 #4 power conductors and 1 #8 grounding conductor. Service will require at least two (2) 40' poles and suitable cable support at eave of barrel storage building. Service wiring shall be messenger supported cable assembly, triplex, multi-conductor cable, classified as hard usage type, or open conductors on insulators. Mount power conductors 30 inches above telephone cable (by others) to provide minimum clearance below telephone cable of 18 feet.

"At the temporary power distribution panel Contractor shall provide and install a 5/8" dia. ground rod, 10' long, main fusible disconnect, 480V, 3 pole, 100 amp, A480V, 60A. fusible switch with 45 amp fuses, A 30 KVA transformer, 480-208Y/120 volt, and A 24-30 pole panelboard, 208Y/120Y, 3 phase-4 wire, with at least 8 GFI, 20 amp, 1 pole, circuit breakers for receptacles and 14, 20 amp, 1 pole circuit breakers for temporary lighting inside new CWS&T facility as required until permanent lights are installed and operating. All electrical equipment installed for temporary power shall be in NEMA 3R (raintight) enclosures.

"Electrical Contractor shall comply with requirements of Article 305 of NEC. "Contractor shall furnish and install any additional electrical equipment required for the construction phase of this job, including work under Contract 3.

"Contractor shall furnish all lighting fixtures required for temporary lighting inside CWS&T facility to maintain a level of approximately 15-20 foot candles at floor level. Room 1 and 2 will require the equivalent of 9, 2-lamp F96T12 VHO fluorescent fixtures; Room 6 & 7 will require the equivalent of 12 2-lamp F96T12 SHO fluorescent fixtures.

"After the completion of Contract 2, all temporary electrical facilities shall be removed by the Contractor as directed by P&W (United)".

B. CHANGES TO DRAWING NO. FS-030507-E

DRAWING TITLE SHEET

On the Index of Drawings, add under Electrical:
"E-6 Wiring Diagrams"

SHEET L-5 ELECTRICAL PLAN & MISC. DETAILS

On Electrical Plan Building E, Contractor shall extend security (alarmed doors) cable, 2C#18, through new 3/4" conduit from new junction box shown to an existing cable tray, mounted above the indicated east-west aisle, approximately 900' west and 400' south to security headquarters at Bldg. Column N-1. Terminate cable run as directed by P&W (United) for connection to security alarm system by others.

Contractor shall install a 2" conduit from new junction box shown to existing cable tray above east-west aisle for use by telephone company.

Note: Fire alarm cable shown routed with telephone cable to the CWS&T facility remains Contractor responsibility.

SHEET S-2 ROOF FRAMING PLAN

On the Roof Framing Plan, delete the joist shown 8'-6" east of column Line 10 between column Lines B and C, and delete note reading: "Extra joist where piping is concentrated".

On the Roof Framing Plan, add a framed roof opening for exhaust Fan 5 located immediately east of column Line 10 and north of column Line B2.

SHEET S-4 FOUNDATION DETAILS

Section 16/S4 shall be revised as shown on Sketch No. S-4-1 attached to this Addendum.

SHEETS E-1, E-2 AND E-4

Electrical conduits supported from the roof trusses and passing through the fire walls at column lines 5 and 5', shall be installed using flexible conduit as shown on Sketch No. E-1-1 attached to this Addendum.

B. CHANGES TO DRAWING NO. FS-030507-E (CONT'D)

SHEET E-1 POWER PLAN

On the Power Plan, change the power requirements for six louvers on the north wall. The three motorized louvers on the north wall of Room 1 and the three motorized louvers on the north wall of Room 6 each require two motors. Each motor shall be provided with a separate manual starter. Manual starters in Room 1 shall be explosion proof.

On the Power Plan, add start-stop push button stations and associated wiring for RF 1A and RF 1B similar to those shown for RF 2A and RF 2B.

On the Power Plan motor horsepower for EF 1A, 1B, 4A and 4B shall be 2 HP.

On the Power Plan run 3/4" conduit with 4#14 conductors from door operator DO of Door No. 23 to door Operator DO of Door No. 35 for interlocking.

On the Power Plan, power to AC unit shall be 2#12, 1#12 EG-3/4" C.

On the Power Plan add wiring between door operators, 8#14 3/4" C of Doors 45 and 46. Operate both doors from both sides.

SHEET E-3 ELECTRICAL DETAILS

On the Typical Interior HID Lighting Control, add "lights on" indicating lights in control room.

SHEET E-4 AUXILIARY SYSTEMS

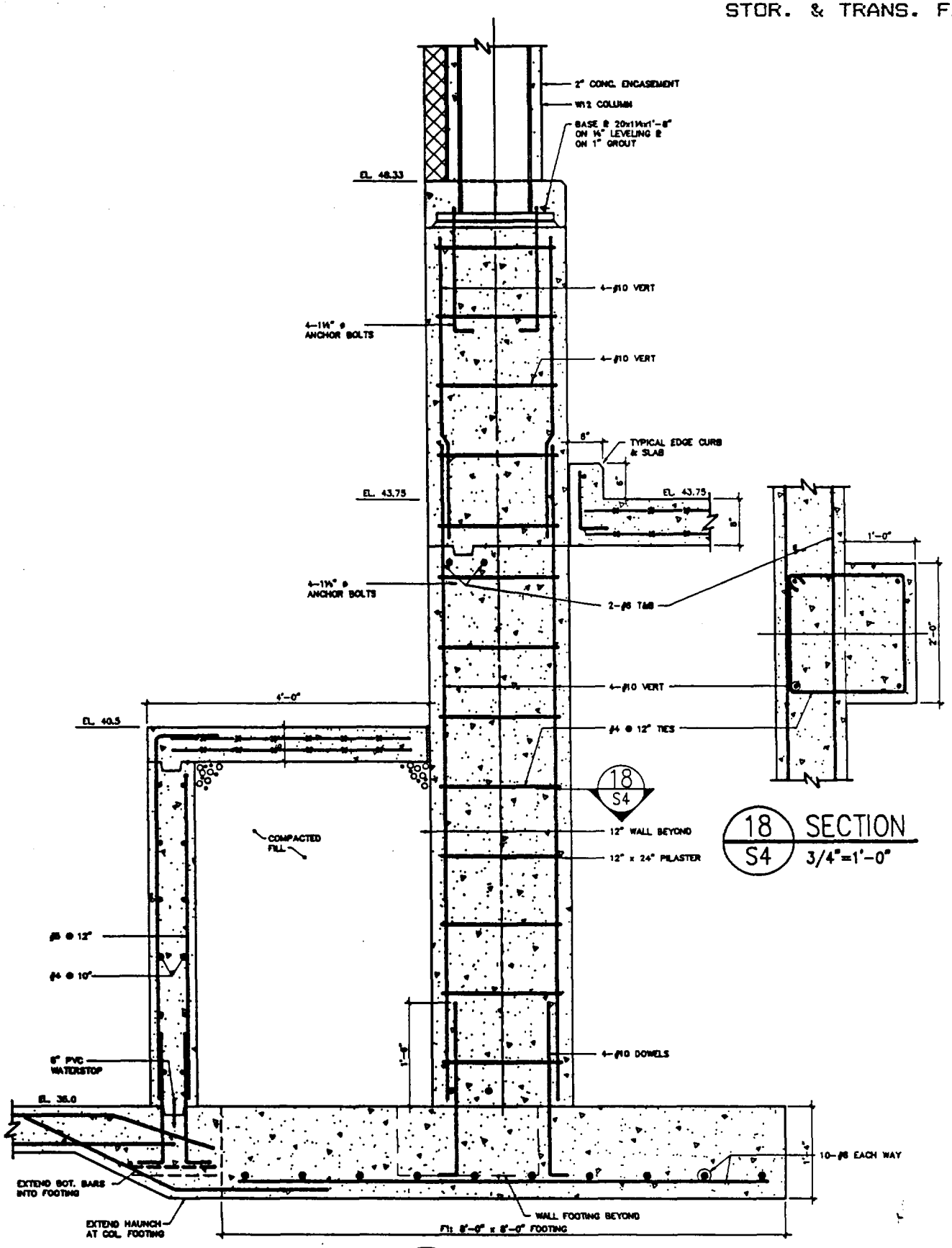
On the Smoke Detectors AH (Duct), add note reading:
"Wire SD1 and SD2 to one point in Kidde Panel. Ditto SD3 & SD4".

On the Handicapped Emergency Call-For-Aid change catalog numbers to:
Light - Simplex 4903-9151 w/plain lens.
Bell - Simplex 2901-9066 with 2975-9027 back box with 4905-9903 adapter plate.
Switch - Simplex 2764-9202.

SHEET E-6 WIRING DIAGRAMS

A new Sheet E-6 is attached to this Addendum.

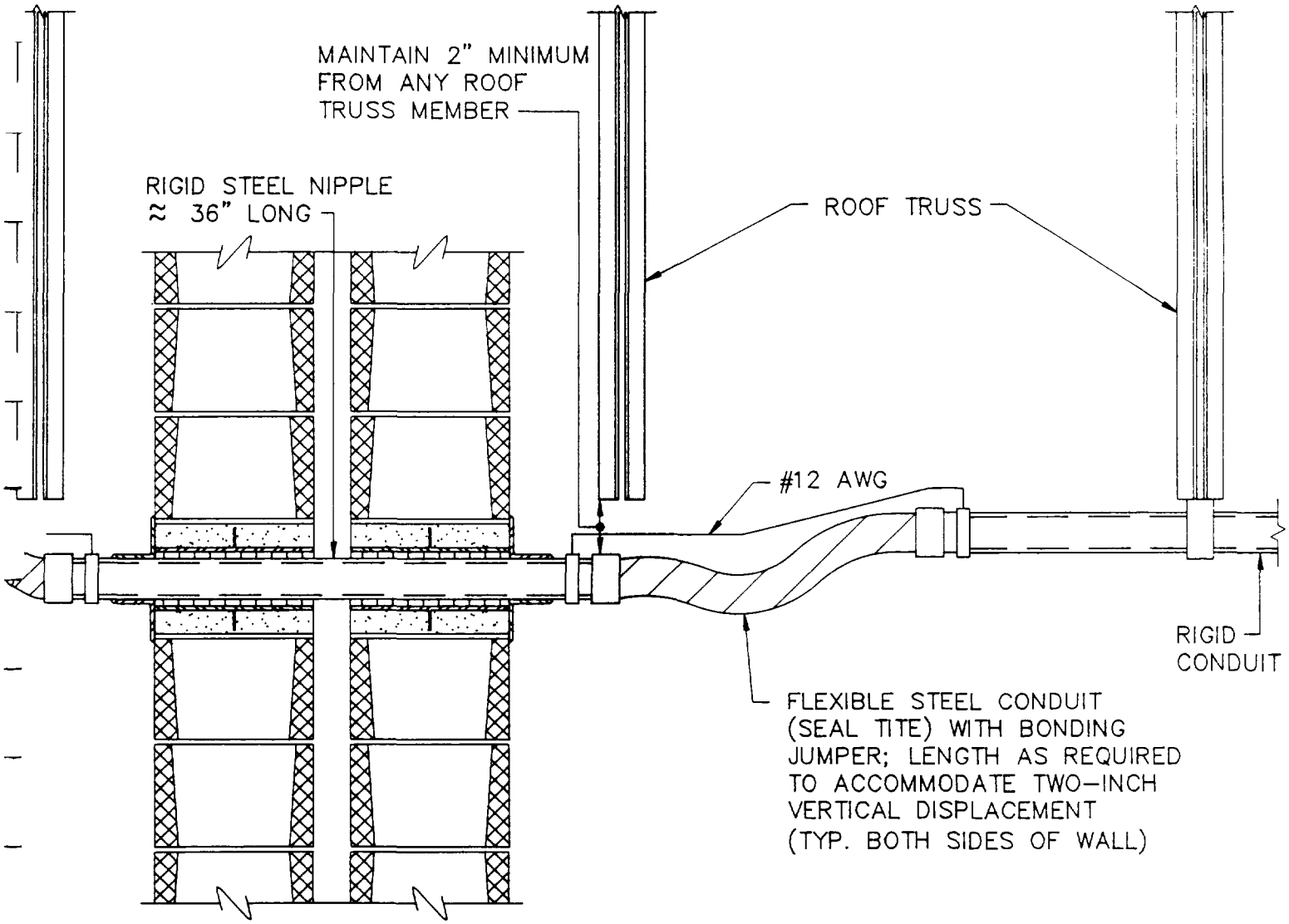
END OF ADDENDUM NO. 1
(See Attached Sketches and Drawing)



18/S4 SECTION
3/4"=1'-0"

16/S4 SECTION
½"=1'-0"

P&W EAST HARTFORD
CENTRALIZED WASTE
STOR. & TRANS. FAC.(2)



SEE SHEET M-2 FOR WALL
PENETRATION DETAIL

ELECTRICAL CONDUIT PASS THRU DETAIL AT FIRE WALL 5 – 5'

ADDENDUM NO. 1
SKETCH NO. E-1-1

UNITED TECHNOLOGIES PRATT&WHITNEY

400 Main Street
East Hartford, Connecticut 06108

July 18, 1991

Maranba Builders, Inc.
1010 Wethersfield Avenue
Hartford, Ct. 06114

Attention: Mr. Roger Barshan

Bulletin No. 1

Re: United Technologies Corporation, Pratt & Whitney Group, Operations Contract dated 6/24/91 for Construction of the Centralized Waste Storage and Transfer Facility, C-91045.

THIS IS A PROPOSAL

This Contractor shall furnish all material and labor required for the completion of the work described, including all items incidental thereto or necessary to complete the work even though not specifically mentioned.

W Specification M-572 for the original work will govern all work unless otherwise mentioned.

The Contractor is requested to submit within seven calendar days a detailed cost estimate of any proposed change to the Contract amount and/or completion time as a result of the work described herein.

PROPOSED CHANGE NO.	DESCRIPTION
1	Revised drawing Sheets S1 to S6 and new Sheet S7 are being issued for clarification of miscellaneous dimensions and details.

Requested by: William G. Winter
William G. Winter

cc: D. Moriarty

UNITED TECHNOLOGIES PRATT&WHITNEY

400 Main Street
East Hartford, Connecticut 06108

July 22, 1991

Maranba Builders, Inc.
1010 Wethersfield Avenue
Hartford, Ct. 06114

Attention: Mr. Roger Barshan

Bulletin No. 2

Re: United Technologies Corporation, Pratt & Whitney Group, Operations Contract dated 6/24/91 for Construction of the Centralized Waste Storage and Transfer Facility, C-91045.

THIS IS A PROPOSAL

This Contractor shall furnish all material and labor required for the completion of the work described, including all items incidental thereto or necessary to complete the work even though not specifically mentioned.

P&W Specification M-572 for the original work will govern all work unless otherwise mentioned.

The Contractor is requested to submit within seven calendar days a detailed cost estimate of any proposed change to the Contract amount and/or completion time as a result of the work described herein.

PROPOSED CHANGE NO.	DESCRIPTION
2	New Sheet S-8 issued for clarification of storage tank piers and pump pad locations within the 16 containment areas shown on Sheet S-1.

Requested by: William G. Winter

William G. Winter

cc: D. Moriarty

UNITED TECHNOLOGIES PRATT&WHITNEY

400 Main Street
East Hartford, Connecticut 06108

August 13, 1991

Maranba Builders, Inc.
1010 Wethersfield Avenue
Hartford, Ct. 06114

Attention: Mr. Roger Barshan

Bulletin No. 3

Re: United Technologies Corporation, Pratt & Whitney Group, Operations Contract dated 6/24/91 for Construction of the Centralized Waste Storage and Transfer Facility, C-91045.

THIS IS A PROPOSAL

This Contractor shall furnish all material and labor required for the completion of the work described, including all items incidental thereto or necessary to complete the work even though not specifically mentioned.

P&W Specification M-572 for the original work will govern all work unless otherwise mentioned.

The Contractor is requested to submit within seven calendar days a detailed cost estimate of any proposed change to the Contract amount and/or completion time as a result of the work described herein.

PROPOSED CHANGE NO.	DESCRIPTION
3	In Section 15600, para. 2.09A, delete the connection to the fire alarm system from the low temperature stat. This contact shall be provided for connection to the alarm annunciator under Contract 3.
4	On Sheets L-4 and L-5, add 45 deg. fittings on the utility connections to the building for non-potable water, fire protection and compressed air.
5	On Sheets A-1, A-7 and S-1 change Door No. 26 to a double door of one 3'-0" X 9'-0" leaf and one 1'-4" X 9'-0" leaf. The new masonry opening is 4'-8".

PROPOSED CHANGE NO.	DESCRIPTION
6	On Sheets A-1 and S-1 move the following 2'-0" to the west: Door No. 20 Transporter unloading station located north of Tank No. 6
7	On Sheet A-6, delete one dovetail slot from each column face which is currently shown with two slots. Add dovetails slots at 24" o.c. to the exterior face of the concrete walls on Lines 1, A and 11 which extend up to Elev. 48.33.
8	On Sheet S-1, the sump shown near column A2-1 shall be 2' wide, 2' deep and 15'-6" long. Details will be provided later.
9	On Sheet S-1, change the centerline-to-centerline dimension of the future mezzanine columns from 10'-9" to 10'-8".
10	On Sheet S-2, where Lintels L-1, L-2 and L-5 bear on masonry walls, grout the masonry solid for two courses below the lintel for a length of 2'-0". Provide two 1/2" X 12" anchor bolts.
11	On Sheet S-4, add #4@12" bent bars to the containment walls north of Tanks 6, 10 and 14, doweling the wall to the slab at El.43.75. Dowels to extend 1'-6" into both slab and wall.
12	On Sheet M-3, delete smoke detectors on supply ductwork from air handlers AH-1, AH-2, AH-3 and AH-4.
13	On Sheet E-4, delete smoke detectors at air handlers AH-1, AH-2, AH-3 and AH-4. Add smoke detectors to the exhaust ductwork to exhaust fan EF-1A, EF-1B, EF-2A, EF-2B, EF-3A, EF-3B, EF-4A and EF-4B (see locations on sheets M-3 and M-4). Revise conduits and wiring accordingly.
14	On Sheet E-5, One-Line Diagram, provide for interruption of power by freeze stat for AH-1, AH-2, AH-3 and AH-4.

Requested by: William G. Winter

William G. Winter

cc: D. Moriarty

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TABLE OF CONTENTS (Cont'd)

END OF SECTION

SECTION 00851

DRAWINGS INDEX

PROJECT TITLE: CENTRALIZED WASTE STORAGE & TRANSFER FACILITY

DRAWING NO.: FS-030507-E

CONTRACT NO.: 2

	SHEET NO.	TITLE
SITE	L-2	Site and Location Plans
	L-3	Site Development Plan
	L-4	Utility Plan
	L-5	Electrical Plan and Miscellaneous Details
ARCHITECTURAL		
	A-1	Floor Plan and Code Information
	A-2	Roof Plan and Details
	A-3	Exterior Elevations
	A-4	Bldg. Sections, Finish Schedule and Details
	A-5	Wall Sections
	A-6	Plan Details
	A-7	Int. Elevations, Door Schedule and Details

	SHEET NO.	TITLE
STRUCTURAL		
	S-1	Foundation Plan
	S-2	Roof Framing Plan
	S-3	Column Schedule
	S-4	Foundation Details
	S-5	Foundation Details
	S-6	Structural Details
MECHANICAL	M-1	Plumbing & Mechanical Room Plan & Details
	M-2	Plumbing and Fire Protection Plan
	M-3	Plan - HVAC
	M-4	HVAC Details
	M-5	Sections and Details
ELECTRICAL	E-1	Power Plan
	E-2	Lighting & Receptacle Plan
	E-3	Electrical Details
	E-4	Auxiliary Systems
	E-5	One Line Diagram and Details

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01010 - SUMMARY OF THE WORK

1. GENERAL

1.01 CONTRACT NO. 2

The Contractor shall perform all work as shown on drawings and as specified herein. These documents cover Contract No. 2, which is part of a group of four construction contracts as described in paragraph 1.02. The primary goal of Contract No. 2 is to construct a storage building ready for occupancy and use of the container storage areas in the north half of the building and use of the support facilities and truck pads and forklift ramp in the south part of the building.

1.02 RELATED CONTRACTS

The overall program for development of the Centralized Waste Storage and Transfer Facility consists of a demolition contract (removal of the Casablanca Building and the Oil House) and four construction contracts as follows:

Contract No. 1 - Early Site Prep
(Relocation of piping and utilities to facilitate new construction)

Contract No. 2 - Building Construction
(as described in paragraph 1.01)

Contract No. 3 - Process Systems
(Tanks, pumps, piping, controls and related systems for storage of liquid wastes in the south half of the new building and for transfer of these wastes to vendors or to the existing Concentrated Waste Treatment Plant; a separate contract will be awarded during construction of Contract No. 2).

Contract No. 4 - Truck Scale
(New truck scale east of the new building with interconnections to the new building for obtaining truck weights. A separate contract will be awarded during construction of Contract No. 2).

1.03 COORDINATION WITH CONTRACT 3 REQUIREMENTS

The work under Contract 2 shall be coordinated with the requirements of Contract 3, particularly with regard to the installation of mechanical and electrical systems. The following shall govern the work under Contract 2:

A. Maintain maximum clearance above truck pads and above future tanks to insure capability for tank removal. Where this is not feasible, provide flanges or similar connections to facilitate dismantling of ducts or piping.

B. Where so designated on drawings, allow space for routing of pipes, ducts and other facilities to be installed under Contract 3.

2. REMOVALS AND RESTORATIONS

2.01 Removals and restorations by the Contractor under Contract No. 2 shall include, but not be limited to :

A. Pavement removal and restoration.
B. Storm drain removal and replacement.
C. Sanitary drain and miscellaneous pipe removal.
D. The Contractor shall restore all areas disturbed by the construction activities as shown on the contract drawings and as specified herein.

2.02 Removals and relocations by United will include:

A. Temporary and permanent fencing
B. Traffic guard rails

3. NEW WORK

New work by the Contractor under Contract No. 2 shall include, but not be limited to the following:

A. Site work including earthwork, utility services and paving.
B. Structural steel framing.
C. Concrete foundations, slabs and tank containments.
D. Concrete masonry walls.
E. Single membrane roof.
F. Doors, windows and other architectural features.
G. Mechanical work including plumbing, fire protection, HVAC and services as required to facilitate process installations under Contract No. 3.
H. Electrical work including power distribution, lighting, alarms, security, communications, and services as required to facilitate process installations under Contract Nos. 3 and 4.

END OF SECTION
SUMMARY OF THE WORK

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01300 - SUBMITTALS

1. GENERAL

1.0 INCLUSIONS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to work specified in this section.

1.02 SCOPE

The Contractor shall submit to United, prior to commencing work, a complete listing of manufacturer's names for equipment and material he proposes to furnish for the job.

A. After review and return by United of the list of manufacturers' names for equipment and material, and prior to delivery of any material to job site, and sufficiently in advance of required delivery date to allow engineering time for checking, Contractor shall submit to United eight (8) copies of detailed dimensioned drawings of all equipment showing construction, size, arrangement, performance characteristics, operating clearances, capacity of equipment, electrical characteristics, and accessories as specified or shown on drawings. All equipment unless otherwise specified shall be a standard catalogued product of an established manufacturer, of equal quality, durability and finish to that specified. United may also request drawings for approval of any items to be constructed or fabricated by Contractor.

B. Drawings, catalogs, samples, specifications, etc., submitted for review shall be clearly labeled indicating equipment, number (per schedule on drawings), specific service or use, job names, Contractor's name, and Manufacturer's name and address. Items for which review is being requested shall be specific, and identification in catalog, pamphlet or drawings shall be clearly made in ink. Data of a general nature, or incomplete in any respect will not be accepted.

C. Following approval of shop drawings, no further changes will be considered without written application from Contractor, and

will not be allowed without written consent or approval of United. Approval of shop drawings does not apply to quantities, nor relieve Contractor of his responsibility of necessity of furnishing material, or performing work required by Contract Drawings and Specifications. Approval of shop drawings shall not be considered a guarantee of measurements or of building conditions.

D. Unless otherwise specified, not less than eight (8) copies of all Contractor's and Subcontractor's drawings shall be submitted to United for review. United will retain six (6) copies of and return two (2) copies to the Contractor and/or Subcontractor.

E. All Contractor's drawings submitted for approval shall be sent directly to United. All drawings submitted by Subcontractors under the Contractor for approval by United, shall first be sent by the Subcontractors direct to the Contractor who shall keep a record of the drawing numbers and date of receipt.

F. The Contractor shall check thoroughly all Subcontractor's drawings regarding measurements, sizes of members, materials and details to satisfy himself that they conform to the intent of United's plans and specifications. Drawings found to be inaccurate or otherwise in error shall be returned to the Subcontractor(s) for correction before submitting them to United. After the Contractor has checked and approved such drawings, he shall place thereon the date of approval and signature of the checker and then submit them to United for review.

G. All Contractor's and Subcontractor's drawings shall be submitted in the order in which materials are needed at the site without necessarily waiting for completion of all drawings before submitting part of them for approval.

H. The Engineer's or Owner's approving or reviewing of the Contractor's and Subcontractors' drawings does not relieve the Contractor from responsibility for errors or omissions which may exist, even though work is done in accordance with such approved or reviewed drawings. Approval or review of Contractor's and Subcontractors' drawings by United is a gratuitous assistance and United does not thereby assume responsibility for errors or omissions. Where such errors or omissions are discovered later, they shall be made good by the Contractor irrespective of any review by United.

END OF SECTION

DIVISION 15 - MECHANICAL

SECTION 15010 - MECHANICAL GENERAL PROVISIONS

1 - GENERAL

1.01 SCOPE

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to work specified in this section.

B. Work covered by this division includes, but is not limited to:

1. Fire protection

2. Plumbing

3. Piping valves and appurtenances

4. Heating and ventilating

1.02 PROGRESS SCHEDULE

A. Keep informed of progress schedules of all other contractors and work in accordance with schedules to completion of this job.

1.03 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Furnish, at completion of job, copies of complete operations and maintenance instructions, neatly bound in leatherette covers. Label each cover with names of Owner, A/E, Contractor and title. Include complete description of operating and maintenance procedures required for all systems, controls and major items of equipment. Turn over any Owner's Manuals furnished with equipment to Owner. Include these procedures in bound volumes. Refer also to the "General Conditions", section of this contract.

1.04 INSTRUCTION OF PERSONNEL

A. Furnish competent service man to instruct Owner's personnel in proper operation and maintenance procedures to be followed, at

completion of job, or when Owner takes over operation of equipment and systems.

B. All Contractor suppled equipment shall include start-up supervision with a factory trained representative.

1.05 GUARANTEE

A. Guarantee all work under this division, in writing, to be free of defective work, materials or parts for a period of two years after acceptance of work by Owner.

B. Repair, revise or replace all leaks, defects, failures or inoperativeness at no cost to Owner.

1.06 DRAWINGS

A. Shop drawings shall be provided for all equipment in accordance with Section 01300; Submittals, and shall conform to the following:

a. For purposed of clarity and legibility, drawings shall be essentially diagrammatic and, the size and location of all equipment shall be drawn to scale wherever possible. The drawings shall reflect the desired location of services such as "home runs", mechanical piping, etc., to the extent possible.

b. Drawings shall indicate required size, points of termination of pipes and conduits, and proper routes to conform to structure, avoid obstructions and preserve clearances. However, it is not intended that drawings indicate all necessary offsets, and it shall be the work of the Contractor to make installation in such a manner as to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear.

c. Install piping as close as possible to locations shown. Notify Owner when any conflicts arise during erection of piping. Make no improvisations or field changes without Owner's prior written approval.

d. Furnish layout drawings to Owner, if required, indicating all changes to meet space requirements, code requirements and as necessary to resolve all space conflicts.

e. All locations of and connections made to equipment shown on the drawings shall be based on preliminary equipment selections. It shall be the responsibility of the Contractor to adjust piping, foundations, etc., to suit

equipment actually purchased. The Contractor shall submit "as-built" drawings in accordance with the "General Conditions" section of this contract to document changes.

1.07 SITE CONDITIONS

A. Submittal of a bid shall indicate Contractor has examined site and has included all required allowances in his bid. No allowance shall be make for any error resulting from Contractor's failure to visit job site. Bid shall include costs for all required drawings and changes as outlined above.

1.08 ACCEPTANCE

A. Completed work shall be in proper working order and clean. Contractor shall leave premises and site in presentable condition, free of surplus materials and debris.

B. Contractor shall furnish all necessary inspection reports, approvals, certificates, and labels, stamps or name plates required by specific standards cited in individual specifications for materials and equipment or component parts.

1.09 EQUIPMENT TAGGING

A. All valves, controls, switches, etc., shall be tagged in accordance with the General Conditions.

1.10 SUBMITTALS

A. Submit manufacturer's literature for all materials and equipment in accordance with requirements of Section 01300; Submittals.

B. Required data shall include but not necessarily be limited to:

a. Unit designation.

b. Unit dimensions and weight.

c. Complete electrical data including wiring diagrams.

d. Complete description of materials and methods of construction including finishes.

e. Installation recommendations.

f. Complete list of recommended spare parts.

C. Coordination of Trades:

a. Layout drawings of equipment, piping ductwork, etc., shall

be fully coordinated with approved architectural, structural and other approved shop drawings as required to define layout constraints.

b. Before submitting layout shop drawings to the Owner for approval, this Contractor shall submit to all other relevant trades including electrical, fire protection, plumbing, piping, heating and ventilating a set of drawings. These drawings shall be checked for conflicts with other trades by a responsible person with that sub-contractor and shall be signed off by that person as an acceptable layout. This set or a copy thereof shall be sent along with the eight sets of shop drawings sent to the Owner for approval.

D. Provide coordination with Contract 3 per Paragraph 1.20.

1.11 MATERIALS

A. Unless otherwise specified, provide only new, first grade equipment and materials which comply with requirements of this specification and applicable standards.

B. Furnish, if required, satisfactory evidence of kind and quality of materials proposed for use.

C. Similar items of material and equipment shall be product of same manufacturer.

1.12 SUBSTITUTION

A. Use only materials and equipment of manufacturers listed in this specification. Where the term "or equal" is used, obtain approval from the Owner before substitution is made.

1.13 INSTALLATION

A. Workmanship shall be first class in every particular and shall conform to best practice for such work.

1.14 MACHINERY GUARDS

A. Provide guards for moving equipment such as fan belt drives and motor drive couplings.

B. Use OSHA approved belt guards and coupling guards. Provide 1/2 inch hole in guard at center of shaft of driven equipment where belt type drives are used.

1.15 SURFACE FINISH

A. Clean all parts free of extraneous materials. Smooth external surfaces and round or bevel all edges where practical.

1.16 PROTECTIVE PAINTING

A. Touch up factory painted equipment that has been damaged during handling or installation. Feather damaged area and apply primer plus two fresh coats to match existing finish.

1.17 INCIDENTAL WORK

A. Coordinate location and proper dimensions of openings in floors, walls and roofs with Architectural and Structural. Forming and pouring equipment pads and foundations, etc., is included in Division 3, CONCRETE. Bear responsibility for cutting and patching and repairing walls, floors, etc., where holes have been incorrectly located or sized. Owner's approval is required before cutting any part where strength or appearance of finished work is involved. Finish up in neat manner to match existing work.

B. Provide all motors and pre-wiring as specified by this division.

1.18 INSPECTIONS

A. Give Owner two days notice of all tests and inspections.

B. Conduct all tests to satisfaction of Owner.

C. Make site available at all times for inspection by Owner.

D. In addition, the following formal inspections by Owner or his authorized representative shall be conducted for the following:

a. Above floor work before being concealed or covered.

b. Final inspection after completion of work.

c. Additional inspections as may be deemed necessary by Owner.

1.19 BUILDING CODES AND LOCAL REGULATIONS

A. Obtain and pay for all permits, inspections, licenses and certificates required for work under this Division. Refer to Division 0 documents.

B. Governmental agencies and authorities having jurisdiction representing the following shall also be complied with:

a. State of Connecticut.

b. Hartford County and Town of East Hartford

c. Other Federal, State and Local authorities having jurisdiction.

d. Pratt & Whitney regulations.

1.20 COORDINATION WITH CONTRACT 3 REQUIREMENTS

The work under Contract 2 shall be coordinated with the requirements of Contract 3, particularly with regard to the installation of mechanical and electrical systems. The following shall govern the work under Contract 2:

A. Maintain maximum clearance above truck pads and above future tanks to insure capability for tank removal. Where this is not feasible, provide flanges or similar connections to facilitate dismantling of ducts or piping.

B. Where so designated on drawing, allow space for routing of pipes, ducts and other facilities to be installed under Contract 3.

1.21 SEISMIC LOADS

Provide lateral supports for equipment and piping as required by the State Building Code for seismic Zone 2.

1.22 INDUSTRY STANDARDS

A. Standards shall include, but are not necessarily limited to, those listed in this Section.

B. Publications shall be as listed in specification sections and issued by the following agencies (references in specification sections may be by abbreviation only):

AABC	Associated Air Balance Council
ADC	Air Diffusion Council
AGA	American Gas Association
AISC	American Institute of Steel Construction
AMCA	Air Movement and Control Association
ANSI	American National Standards Institute
API	American Petroleum Institute

ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials AWS American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
FM	Factory Mutual
FS	Federal Specifications & Standards
IEEE	Institute of Electrical and Electronics Engineers
IRI	Industrial Risk Insurers
LSC	Life Safety Code, NFPA 101
MSS	Manufacturers' Standardization Society of the Valve and Fitting Industry
NBS	National Bureau of Standards, U.S. Dept. of Commerce
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety & Health Administration, U.S. Dept. of Labor
PDI	Plumbing and Drainage Institute
SBC	Standard Building Code
SGC	Standard Gas Code
SMACNA	Sheet Metal & Air Conditioning Contractors National Association
SMC	Standard Mechanical Code
SPC	Standard Plumbing Code
SSPC	Steel Structures Painting Council
UL	Underwriters' Laboratories

END OF SECTION

DIVISION 15 - MECHANICAL

SECTION 15051 - CLEANING AND TESTING PIPE AND EQUIPMENT

1. GENERAL

1.01 SCOPE

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to work specified in this section.

B. This section describes the general procedures to be followed in cleaning and testing piping and fluid handling equipment.

C. Cleaning method, test medium and working pressures are defined for each service on the attached Cleaning and Testing Index. See Part 3 of this specification for complete description of cleaning methods and test procedures.

1.02 SUBMITTALS

A. The proposed testing procedures, including test medium and pressure, line segments and equipment included in the test, methods of isolating test from rest of system and pressure monitoring techniques, shall be approved by the Owner's representative prior to commencement of the test.

B. A detailed report of pressure tests on piping and equipment shall be forwarded in duplicate to the Owner. This report shall show date of test, lines tested, test medium, length of time test pressure was held, pressure drop or rise, and extent of venting or repressurizing.

C. Limits of cleaning and testing must be identified and means provided to isolate new work from existing work.

2. PRODUCT

2.01 GENERAL

A. All detergents, solvents and other cleaning agents shall be compatible with the materials of fabrication of the systems in which they are used. They shall not adversely affect the materials or mechanisms in the systems and they shall be acceptable to equipment manufacturers. All detergents, solvents and other cleaning agents shall also be compatible with the process streams to be handled by the systems in which they are used.

B. Blinds, gaskets, bolts, etc., used in isolating segments of systems shall conform to the specification for adjacent materials.

C. Contractor shall furnish all labor, tools and equipment required for pressure testing piping systems.

3. EXECUTION

3.01 CLEANING

A. General:

a. The Contractor shall provide and install all necessary temporary connections, strainers and other equipment to thoroughly clean the piping systems before start up. The Contractor is responsible for disposing of all cleaning agents and removing all temporary connections and strainers after cleaning is complete.

b. Piping should be cleaned just prior to installation and/or plant start up when possible. All cleaned piping material shall be protected against contamination by sealing all open ends with clean plastic sheet or metal foil.

c. All cleaning procedures shall be subject to the approval of the Owner, or his designated representative, and will be completed to his satisfaction.

3.02 CLEANING METHODS

A. Cleaning Method "D":

a. Prior to Erection:

1. Surface clean as required.

2. Blow with air or hose with potable water and visually inspect for contaminants.

3. Dry and seal the ends of pipes stored before erection to prevent contamination during storage.

B. Cleaning Method "F":

Flush and clean interior of fire protection system in accordance with applicable NFPA Standards.

3.03 DISINFECTION OF POTABLE WATER SYSTEMS

A. Provide nipples and valves as required to introduce disinfectant and water, to vent air and to drain the solution, whether or not these connections are shown on the drawings.

B. Clean the system as specified in the attached Cleaning and Testing Index.

C. Fill the system uniformly with a disinfection solution of 50 ppm available chlorine. The disinfectant shall be retained no less than 24 hours. As an alternate, a solution of 300 ppm held for three hours is also acceptable. After the holding period, a test for residual chlorine shall be made. If none is found, the system shall be drained and the disinfection procedure repeated. When a positive residual chlorine test is accomplished, the system shall be flushed with potable water and put into operation. The methods used for disinfection should be in accordance with the latest published procedure of the AWWA C601.

D. For very minor jobs, such as replacement of a single fitting or repair of a valve, the item being installed can be precleaned and then disinfected by immersing it in a solution of 300 ppm of chlorine for one hour.

E. Disinfection solution for PVC piping shall not exceed 200 ppm available chlorine.

3.04 TESTING

A. General

a. Equipment such as vessels, pumps, and the like shall be isolated during testing of the piping system. Retest of equipment which has been shop tested is not absolutely required unless the equipment has been damaged or disassembled during shipment or erection. The test pressure for such a reset shall not exceed the shop test pressure and the Owner shall determine whether or not a retest is required. Inclusion of the equipment in the testing of piping systems shall not be done without approval of the Owner.

b. Test pressure shall be 1.5 times the working pressure indicated in the Cleaning and Testing Index. Final test pressure for each test shall be maintained for a sufficient length of time to facilitate a complete inspection of all joints and connections, but no less than the specified by

the applicable testing procedure. When it is necessary, for practicality, to include a vessel or other equipment, the test pressure shall not exceed the allowable cold limit of the equipment.

c. All leaks detected must be repaired. Piping systems shall be retested if revisions or repairs are made in piping or pressure equipment.

d. Since the risk of failure, with the attendant possibility of injury, is appreciably greater during testing, all safety measures required by codes or ordinances applicable to the situation shall be taken.

e. Equipment or piping to be pressure tested shall not be insulated, covered, painted or concealed prior to that test. Compression joint underground piping may be backfilled prior to pressure test except that joints shall remain exposed until after the test, but tie rods, clamps, etc., shall be in place and fastened.

f. Test, including the inspection of all joints, shall be made to the satisfaction of the Owner's representative. Following the completion and approval of the test, restore all components of the system to normal operating condition. This includes eliminating any temporary provisions installed.

B. Preparation for Testing:

a. Remove from the system all pumps, turbines, traps, shock arrestors, expansion joints, instruments, control valves, safety valves, rupture discs, filters, orifice plates, etc., which might be damaged by the test, or are designated by the Owner's representative. Also remove all items such as orifice plates which might trap air in a system to be hydrostatically tested. Disconnect all instrument supplies.

b. Open but do not backseal all valves including bypass valves. Lines containing check valves shall have the source of test pressure on the upstream side.

c. Clean system prior to testing.

d. Systems may be separated into sub-systems for testing if such action will expedite or simplify the testing.

C. Test Procedure T1 (Hydrostatic Test):

a. Only filtered water shall be used as test medium.

b. No testing shall be done when the ambient temperature is 40° or lower.

c. Test pressure shall be at one and one-half times the maximum anticipated working pressure but in no case shall the test pressure be less than 100 psig.

d. Provide vents and drains as required.

e. All lines shall be thoroughly cleaned before testing.

f. Items which are not to be subjected to the hydrostatic test shall be either removed or blanked off. Short sections of piping which must be removed to permit the installation of blinds or blanks must be tested separately.

g. The test pump hook-up for hydrostatic test shall be such that the pressure may be applied gradually under perfect control. A valve shall be provided for blocking in the piping during the test period. The system should be filled with water through a low connection point, care being taken that air is completely vented so that there are no air pockets remaining. The pressure shall be applied gradually and held at the specified value for the time required to visually check each weld, connection, joint, flange, etc., but not less than a minimum of two hours. Test readings may be taken at the lowest point of the line or system of lines providing static head is added to the minimum hydrostatic test pressure. Care shall be taken to ensure that at no point a dangerous over-pressure is experienced.

h. The hydrostatic test shall be considered satisfactory if no visible leakage, cracks or other signs of distress are discovered on the piping or at any joints. There is no requirement for minimum pressure drop during the test period; however, the cause of any pressure loss other than that due to temperature change or similar reasons shall be justified to the satisfaction of the Owner's representative.

i. Minor leaks in screwed or flanged joints may be repaired without retesting subject to the approval of the Owner's representative.

j. Any welded joint found leaking shall be repaired in accordance with the original welding procedure and completely retested.

k. After completion of hydrostatic testing, the system shall be

completely drained at all low points in such a way as to accomplish thorough flushing of the system. All test blinds, temporary supports, test equipment, etc., shall then be removed, and any valves, orifice plates, short sections of piping, miscellaneous in-line equipment or instruments that were removed prior to testing shall be re-installed and the line left ready for service. New gaskets shall be used when re-installing flanged items.

1. Care shall be taken to ensure the complete removal of all water from the line or system after testing. If there is any danger of contamination or freezing, blowing out the fluid with dry, oil-free air is necessary.

D. Cleaning and Testing Index:

Service	Cleaning Method	Working Pressure (psig)	Test Method
Potable Water, Cold	D	100	T1
Steam	D	30	T1
Steam Condensate	D	50	T1

END OF SECTION

DIVISION 15 - MECHANICAL

SECTION 15180 - INSULATION

1. GENERAL

1.01 SCOPE

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 specification sections, apply to work specified in this Section.

B. This work consists of all labor and materials for the insulation of new or relocated equipment and piping being installed under other Sections of this Division including, but not limited to, the following:

Hot Piping

Steam and condensate pipe insulation - interior.
Roof drains - interior

Cold Piping

Domestic Hot and Cold Water - interior.

C. Prior to work of this Section systems to be insulated are to be complete. Systems (or portions thereof) to receive approval and release for insulation must have successfully passed all specified tests and be complete.

2. PRODUCTS

2.01 PIPE INSULATION MATERIALS

A. Fiberglass Pipe Insulation: FS HH-I-558, Form D, Type III, Class as indicated.

1. Provide Class 12 for piping where highest temperature does not exceed 450 degrees F. (232 degrees C.).

B. Fiberglass Pipe Fitting Insulation: FS HH-I-558, Form E, Class as indicated.

1. Provide Class 16 for use with Class 12 fiberglass pipe insulation where temperature does not exceed 450 degrees F. (232 degrees C.).

C. Vapor Barrier Material: FS HH-B-100, Type I, paper-backed aluminum foil, except as otherwise indicated, strength and permeability rating equivalent to adjoining pipe insulation jacketing.

D. Staples, Bends, Wires and Cement: As recommended by insulation manufacturer for applications indicated.

E. Adhesives, Sealers and Protective Finished: As recommended by insulation manufacturer for applications indicated.

F. All insulation shall have composite (insulation, jacket and adhesives) fire and smoke hazard ratings as tested under procedure ASTM E-84, NFPA 255 an UL 723 not exceeding: Flame Spread 25 and Smoke Developed 50. Accessories, such as adhesives, mastics, cements and cloth for fittings shall have same component ratings as listed above. Paper laminate jackets shall be permanently fire and smoke resistant. Chemicals used for treating paper in jacket laminates shall not be water soluble and shall be unaffected by water and humidity. The Insulation Subcontractor shall certify to the above, in writing, prior to installation.

G. Materials shall be Owens/Corning, Johns-Manville, Certainteed or approved equal.

3. EXECUTION

3.01 PLUMBING PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on exposed plumbing fixture runouts from faces of wall or floor to fixture; on unions, flanges, strainers, flexible connections, and expansion joints.

B. Cold Piping:

1. Application Requirements: Insulate the following cold piping systems.

a. Cold potable water piping

b. Horizontal roof drains.

2. Insulate each piping system specified above with the following types and thickness of insulation:

a. Insulation: Fiberglass; 1" thickness.

3.02 HOT PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on hot piping within unit cabinets; on cold piping within unit cabinets, provided piping is located over drain pan; and on unions in hot water piping.

B. Hot Water and Steam Piping (to 150 degrees F/121 degrees C):

1. Application Requirements: Insulate the following hot piping systems:

a. Low pressure steam and condensate piping.
b. Hot potable water piping.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:

a. Insulation: Fiberglass; 1" thick for pipe sizes up to and including 1", 1-1/2" thick for pipe sizes 1-1/4" through 4".

3.03 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that insulation serves its intended purpose. Stapling is not acceptable. Where metal bands are used, they shall be 3/4" wide brass or aluminum bands spaced to hold the ends and center of each section of insulation, but in no case shall spacing exceed 18 inches.

B. Install insulation on pipe systems subsequent to testing and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full length units of insulation with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Longitudinal seams shall be kept on the top of the pipe and shall be smoothly secured with sealing lap. Circumferential seams shall be covered with pressure sealing tape of same material.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor-barrier jackets on pipe insulation and protect to prevent puncture or other damage.

F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

G. On roof drain piping, insulation on horizontal runs shall extend to cover the fitting at transitions to the vertical. Insulate roof drain bowls.

H. Extended piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

I. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation.

J. Pipe Hanger Insulation Inserts: Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3 inch wide vapor barrier tape or band over the butt joints. For cold piping, apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3 inch wide vapor barrier tape or band.

K. All piping exposed to the weather shall have an aluminum jacket to protect the insulation. Jackets shall be 0.016 inch thick. Side and end laps shall be at least two inches wide and cut edge of side lap shall be turned under one inch to provide a smooth edge. Laps shall be placed to shed water. Jackets shall be secured in place with aluminum bands on nine inch centers or aluminum screws on five inch centers.

3.04 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation installer shall advise Contractor of required protection for insulation work during remainder of construction period to avoid damage and deterioration.

END OF SECTION

DIVISION 15 - MECHANICAL

SECTION 15400 - PLUMBING

1. GENERAL

1.01 SCOPE

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to work specified in this section.

B. The work of this Section includes all labor, materials, and equipment required to provide:

1. Domestic hot and cold water piping systems;
2. Drain, waste, and vent systems;
3. Plumbing fixtures and trim.
4. Air and non-potable water piping.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to United, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. All current OSHA requirements shall be complied with.

D. Plumbing fixtures, valves, and accessories shall be equal to those specified, and limited to manufacturers specified or those listed below:

Plumbing Fixtures - Kohler, Crane or Standard
Fixture Carriers - Zurn, J.R. Smith, Wade, Josam
Flush Valves - Sloan
Cleanouts - Josam, Zurn, Wade, J.R. Smith

Electric Water Heaters - Hubbell, A.O. Smith, Rheem, Jackson
Insulation - Gustin-Bacon, Baldwin-Hill, Owens-Corning, L.O.F.
Valves (Gen. Purpose) - Crane, Jenkins, Walworth, Kennedy, Powell
Valves (Relief) - Crane, A.W. Cash, Crosby, Watts, Keckley, McDonald-Miller

1.03 SUBMITTALS

A. Shop drawing submittals shall be in accordance with Section 01300, submittals.

B. Submittals shall include:

1. Materials list of items proposed to be provided under this Section;

2. Manufacturer's specifications, catalog cuts, and other data needed to prove compliance with the specified requirements;

3. Shop Drawings and other data as required to indicate method of installing and attaching equipment.

C. Upon completion of water piping sterilization, deliver to United two copies of an acceptable Certification of Completion.

1.04 PRODUCT STORAGE AND HANDLING

A. Receive and handle all materials with care so as not to cause damage

B. Use proper tools, equipment and procedures to handle and lay pipe. Do not damage pipe coatings, wrappings or linings. Repair or replace damaged pipe coatings, wrappings or linings in accordance with manufacturer's instructions or as required to restore original protection.

C. Inspect all materials, upon receipt, for defects and for compliance with Specifications. Tag, stencil or otherwise permanently identify all materials with particular care to adequately identify specialty items.

D. All piping materials to have factory applied identification (i.e. ASTM A-74).

E. Properly store all pipe, piping materials, equipment, etc., so as to prevent deterioration while in storage. Store all materials off ground or off floor. Store inside or cover all materials subject to deterioration from weather. Protect all factory applied identification.

F. Store loose materials such as fittings, gaskets, bolts, nuts, small valves, and specialties in adequate number of bins to properly separate. Protect ends of fittings, valves and pipe from weather and abuse.

2. PRODUCTS

2.01 PIPE SCHEDULE

A. The drain, waste, and vent system for work below the floor and outside underground to five feet away from structures shall be service weight cast iron pipe and fittings with neoprene push-on joints. For aboveground provide service weight cast iron pipe and fittings with no-hub joints. Buried roof drain piping shall be ductile iron with push-on joints.

B. The water system piping shall be Type "L" copper with sweated connections for aboveground and Type "K" copper with sweated connections for below ground.

2.02 MATERIALS

A. Cast iron soil pipe and fittings shall be service weight cast iron conforming to ASTM A74, or hubless type.

B. Galvanized or black steel pipe shall be standard weight complying with ASTM A12.

C. Fittings for copper lines shall be copper fittings. Fittings for steel lines shall be service weight cast iron type fittings.

F. Unions for copper lines shall be copper fittings. For connections in iron pipe lines 2½" and smaller, provide ground joint brass-to-iron fittings.

2.03 VALVES

A. Valves on potable water system shall be ball valves, with sweated connections, Apollo or equal.

B. Gate valves for shut-off of air and non-potable water lines shall be solid wedge disc, rising stem, 200 psi rating, non-shock. Three-inch air shut-off valve shall be Crane #424, bronze, screwed. Four-inch non-potable water shut-off valve shall be Crane #465, iron body, bronze trimmed, flanged.

C. Check valves three-inch and smaller shall be Crane #37, bronze, screwed, Y-pattern, 200# WOG, swing check type.

2.04 BACKFLOW PREVENTER

A. Reduced Pressure Backflow Preventer shall be a Clayton 1-1/2" Model RP as manufactured by Cla-Val Co., Newport Beach, CA or approved equal, consisting of two independently acting spring loaded check valves, an automatically operating pressure differential relief valve, gate valves located at each end of the device and shall be fitted with properly located test cocks. The backflow preventer should be rated to a maximum working pressure of 150 psi and a temperature of 140°F. Valves shall be of a bronze ASTM B-61 construction.

2.05 WATER METER

A. Water meter shall be a 1" bronze positive displacement type meter with a hard rubber disc, rated for 250 psi. Meter shall be equipped with a mechanical totalizer with units of cubic feet. Water meter shall be Hersey Niagara Model No. N3B1C3A100 with Model No. R-10 totalizer or equal as manufactured by Neptune.

2.06 FLASHING

A. Where pipes of this Section pass through the roof, flashing shall be furnished and installed by roofing contractor; piping shall be adequately supported by plumbing contractor.

2.07 PIPE HANGERS

A. Water piping hangers shall be equal to Fee and Mason #212 split ring hangers with supporting rods; provide Semco "trisolators."

B. Soil and waste piping hangers shall be equal to Fee and Mason #212 adjustable ring hangers with supporting rods. Use Fee and mason #241 riser clamps as required.

2.08 CLEANOUTS

A. Cleanouts shall be equal to Smith #4103 with cast iron body and nickel bronze top.

B. Provide cleanout plugs of extra heavy bronze.

2.09 FIXTURES

A. Water closets shall be vitreous china, siphon jet action, wall mounted, American Standard "Afwall" No. 2477.016 complete with Sloan Royal 110-3-YB flush valve and Olsonite No. 95 black seat.

B. Urinal shall be white vitreous china, American Standard "Washbrook" No. 6501.010, with Sloan Royal 186 flush valve.

C. Lavatories shall be American Standard "Aqualyn", self rimming, white vitreous china complete with Delta 500 single lever faucet and 1-1/4" trap.

D. Water cooler shall be Elkay EBFS-8 for handicapped access.

E. Service sink shall be Fiat molded stone MSB-3624, 36" x 14". Faucet shall be Fiat No. 830-AA service faucet with vacuum breaker, stops, wall brace, pail hook, and 3/4" hose threaded on spout.

F. Emergency shower and eye/face wash combination units (4) shall have a deluge shower head with chain operated self closing valve mounted on a 1½" I.P. stanchion with floor flange. Eye and face wash fixture shall be of stainless steel with a hand operated valve. Emergency shower shall be Speakman No. SE-601, or approved equal.

2.10 ROOF DRAINS

A. Roof drains shall be cast iron equal to Josam 21500 series with polypropylene dome and 4" outlet.

2.11 ELECTRIC WATER HEATER

Electric water heater shall be A.O. Smith Model No. DSE-5 with input of 3KW and recovery rate of 15 gph at 80° F temperature rise. Heating element shall operate on 480 volt three phase power. Tank shall be lined with glass and shall have an anode rod. Tank shall have 5 gallon capacity and shall be insulated to meet ASHRAE Standard 90. Unit shall have immersion screw-in elements, immersion thermostat, 120V control circuit and magnetic contactors.

2.12 INSULATION

Insulate hot and cold water lines and horizontal roof drains in accordance with Section 15180. All supplies and traps shall be

insulated. Insulation on horizontal roof drain piping shall extend to cover the fittings at transitions to the vertical. Insulate roof drain bowls.

2.13 SLEEVES

Where pipes pass through concrete, masonry, or stud walls, or pass through ceilings, provide sleeves of the size required.

2.14 OTHER MATERIALS

Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of United.

2.15 PRESSURE GAGES

Pressure gages shall be Ashcroft, Cat. No. 1000, or approved equal, with a 3-1/2 inch dial, plastic crystal, S.S. movements and a 1/4 inch NPT lower connection. Range shall be 0-100 psig.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PLUMBING SYSTEM LAYOUT

a. Lay out the plumbing system in careful coordination with the Drawings, determining proper elevations for all components of the system and using only the minimum number of bends to produce a satisfactorily functioning system.

B. Follow the general layout shown on the Drawings in all cases except where other work may interfere.

C. Lay out pipes to fall outside the walls of the toilet room and control room or in the ceiling space above the toilet room.

3.3 INSTALLATION OF PIPING AND EQUIPMENT, GENERAL

A. General:
1. Proceed as rapidly as the building construction will permit.

2. Thoroughly clean items before installation Cap pipe openings to exclude dirt until fixtures are installed and final connections have been made.

3. Cut pipe accurately, and work into place without springing or forcing, properly clearing windows, doors, and other openings. Excessive cutting or other weakening of the building will not be permitted.

4. Show no toolmarks or threads on exposed plated, polished, or enameled connections from fixtures. Tape all finished surfaces to prevent damage during construction.

5. Make changes in directions with fittings; make changes in main sizes with eccentric reducing fittings. Unless otherwise noted, install water supply and return piping with straight side of eccentric fittings at top of the pipe.

6. Run horizontal sanitary drainage piping at a uniform grade of ¼" per ft., unless otherwise noted. Run horizontal roof drain piping at a uniform grade of 1/8" per ft. Run horizontal water piping with an adequate pitch upwards in direction of flow to allow complete drainage.

7. Provide sufficient swing joint, ball joints, expansion loops, and devices necessary for a flexible piping system, whether or not shown on the drawings.

8. Support piping independently at pumps, coils, tanks, and similar locations, so that weight of pipe will not be supported by the equipment.

9. Securely bolt all equipment, isolators, hangers, and similar items in place.

10. Support each item independently from other pipes. Do not use wire for hanging or strapping pipes.

11. Provide complete dielectric isolation between ferrous and non-ferrous metals.

12. Provide union and shut off valves suitably located to facilitate maintenance and removal of equipment and apparatus.

B. Equipment access:

1. Install piping, equipment, and accessories to permit access for maintenance. Relocate items as necessary to provide such access, and without additional cost to United.

2. Provide access doors where valves, motors, or equipment requiring access for maintenance are located in walls or chases or above ceilings. Coordinate location of access doors with other trades as required.

C. Gages:

1. Install pressure gages on incoming potable water line and on outlet of hot water heater.

2. Install gages with suitable gage cock.

3.4 PIPE JOINTS

A. Copper tubing:
1. Cut square, remove burrs, and clean inside of female filling to a bright finish.

a. Apply solder flux with brush to tubing.
b. Remove internal parts of solder-end valves prior to soldering.

2. Provide dielectric unions at points of connection of copper tubing to ferrous piping and equipment.

3. For joining copper tubing, use:

a. Water piping 3" and smaller: 95-5 solder;

B. Leaky joints:

1. Remake with new material.
2. Remove leaking section and/or fitting as directed.
3. Do not use thread cement or sealant to tighten joint.

3.5 PIPE SUPPORTS

A. Support suspended piping with clevis or trapeze hangers and rods.

B. Space hangers and support for horizontal steel pipes according to the following schedule:

Pipe size:	Maximum spacing on centers:
1¼" and smaller:	8' - 0"
1½" to 3":	10' - 0"

C. Space hangers and support for horizontal copper tubing according to the following schedule:

Tube size:	Maximum spacing on centers:
1" and smaller:	6'-0"
1-½":	7'-0"
2":	8'-0"
2-½":	9'-0"

D. Space hangers for no-hub cast iron piping at a maximum interval of five feet.

E. Provide lateral supports as required for seismic zone 2 loadings; as a minimum provide sway bracing on hangers longer than 18":

F. Support vertical piping with riser clamps secured to the piping and resting on the building structure.

G. Provide insulation continuous through hangers and rollers. Protect insulation by galvanized steel shields.

H. Arrange pipe supports to prevent excessive deflection, and to avoid excessive bending stress.

3.6 SLEEVES AND OPENINGS

A. Provide sleeves for each pipe passing through walls, partitions, floors, roofs, and ceilings.

1. Set pipe sleeves in place before concrete is placed or masonry walls are built.

2. For uninsulated pipe, provide sleeves two pipe sizes larger than the pipe passing through, or provide a minimum of ½" clearance between inside and outside of the pipe.

3. For insulated pipe, provide sleeves of adequate size to accommodate the full thickness of pipe covering, with clearance for packing and calking.

B. Calk the space between sleeve and pipe or pipe covering, using a noncombustible, permanently plastic, waterproof, non-staining compound which leaves a smooth finished appearance, or pack with noncombustible rope, or fiberglass to within ½" of both wall faces, and provide the waterproof compound described above.

C. Finish and escutcheons:

1. Smooth up rough edges around sleeves with plaster or spackling compound.

2. Provide 1" wide chrome or nickel plated escutcheons on all pipes exposed to view where passing through walls, floors, partitions, ceilings, and similar locations.

a. Size the escutcheons to fit pipe and a covering.
b. Hold escutcheons in place with set screw.

3.7 CLEANOUTS

A. Secure approval from United for locations for cleanouts prior to installation. In general, cleanouts shall be provided at all changes in direction and where shown on drawings. Provide cleanout tees on vertical roof drains accessible from floor level.

B. Provide cleanouts of same nominal size as the pipes they serve; except where cleanouts are required in pipes 4" and larger provide 4" cleanouts.

C. Make cleanouts accessible. After pressure tests are made and approved, thoroughly graphite the cleanout threads.

3.8 VALVES

A. Provide valves in water systems. Locate and arrange so as to give complete regulation of apparatus, equipment, and fixtures.

B. Provide valves in at least the following locations:

1. In branches and/or headers of water piping serving a group of fixtures.

2. On both sides of apparatus and equipment.

3. For shutoff of risers and branch mains.

4. For flushing and sterilizing the system.

5. Where shown on the Drawings.

C. Locate valves for easy accessibility and maintenance.

D. Install shut-off valves on non-potable water service line and air line. Install blind flange on non-potable water valve and plug on air valve.

3.09 BACKFLOW PREVENTION

A. Protect plumbing fixtures, faucets with hose connections, and other equipment having plumbing connection, against possible back-siphonage.

B. Install backflow preventer.

C. Arrange for testing of backflow devices as required by the governmental agencies having jurisdiction.

3.10 PLUMBING FIXTURE INSTALLATION

A. Installation:

1. Set fixtures level and in proper alignment with respect to walls and floors, and with fixtures equally spaced.

2. Provide supplies in proper alignment with fixtures and with each other.

3. Provide flush valves in alignment with the fixture, without vertical or horizontal offsets.

B. Grout wall and floor mounted fixtures watertight where the fixtures are in contact with walls and floors.

C. Install fixtures to comply with handicapped access regulations.

3.11 CLEANING, TESTING AND DISINFECTION OF PIPING SYSTEMS

A. Piping and appurtenances shall be cleaned, tested and disinfected in accordance with Section 15051.

B. Where tests show materials or workmanship to be deficient, replace or repair as necessary, and repeat the tests until the specified standards are achieved.

C. Adjust the system to optimum standards of operation.

END OF SECTION

DIVISION 15 - MECHANICAL

SECTION 15500 - FIRE PROTECTION SYSTEM

1. GENERAL

1.01 SCOPE

A. Drawings and general provisions of the Contract, including the General conditions and other Division 0 Specification sections, apply to work specified in this section.

B. The work of this Section includes detailed design plus all labor, materials, and equipment required to complete the fire protection systems as herein specified, including the following:

a. Provide an in-line balanced pressure proportioning foam-water system including polyethylene foam storage tank, in-line balanced pressure proportioner and foam concentrate pump. In addition, provide a wet-pipe foam-water sprinkler system to protect the west section of the facility from column lines 1-5. Foam tank and proportioning system shall be installed in the Fire Protection Room near Column C-1.

b. Provide a wet pipe sprinkler system to protect the remainder of the facility from column line 5' to column line 11.

c. Provide and install the required local and panel-mounted instrumentation for the fire protection system.

d. Provide complete fire system acceptance tests.

e. Provide complete hydraulic calculations for all systems.

f. Provide tags, charts, and valve identification.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Underground 8" fire main from existing 12" fire main to an 8" flange 12" above the floor in the fire protection room near column C-1 - In Section 02713.

B. Underground 8" fire main from existing 8" stub to an 8" flange, 12" above the floor in the east end of the facility - In Section 02713.

C. Field wiring from fire protection devices to the monitoring panel and from the monitoring panel to the closest existing fire protection panel - In Section 16400.

1.03 SUBMISSIONS

A. Submit data in accordance with Section 01300; Submittals.

B. Submittals shall include:
1. Eight copies of drawings and specifications describing details of materials of construction, tank layout and accessories, pump equipment, sprinklers and sprinkler manifolds, piping, valves, instrumentation, control panel, electricals, and all other system components. Installation instructions shall also be included.

2. The following certifications and guarantees:

a. Hydraulic calculations.
b. Manufacturer's guarantees for all proprietary equipment.
c. Leak test certificates.
d. Inspection and approval certificates.
e. Certification of all welder's qualifications prior to site welding.

3. Operation and Maintenance Manuals for all equipment and systems. These manuals shall include control system line diagrams and panel layout drawings as well as a valve identification list.

4. A list of recommended spare parts.

C. All submittals shall be approved by United prior to execution of work.

1.04 PRODUCT STORAGE AND HANDLING

A. Receive and handle all materials with care so as not to cause damage.

B. Use proper equipment and procedures to lift and handle tanks, using lifting lugs where provided, in accordance with manufacturer's instructions.

C. Inspect all materials, upon receipt, for defects and for compliance with Specifications. Tag, stencil or otherwise permanently identify all materials.

1.05 STANDARDS

A. The Fire Protection System shall comply with the following standards, unless otherwise specified. All codes, standards, and specifications shall be the latest published revisions of such references in effect on date bids are due.

a. National Fire Protection Association (NFPA) standards:

11 Low Expansion Foam and Combined Agent Systems

13 Installation of Sprinkler Systems

16 Foam-Water Sprinkler and Spray Systems

20 Installation of Centrifugal Fire Pumps

70 National Electrical Code

72A Local Protective Signaling Devices

72B Auxiliary Protective Signaling Devices

72D Proprietary Protective Signaling Devices

72E Automatic Fire Detectors

90A Installation of Air Conditioning and Ventilating Systems

b. Factory Mutual Systems, Approval Guide and FM 5-40, Alarm System Data Sheet.

c. Underwriter Laboratories, Inc., Fire Protection Equipment List and Gate Valves for Fire Protection Service (262-83 and Am76).

B. Equipment and component parts thereof shall bear manufacturer's nameplate, giving manufacturer's name, size, type and model number or serial number to facilitate maintenance and replacements. Nameplates of distributors or contractors are not acceptable.

C. All materials of construction shall be in accordance with latest ASTM standards. Equipment and materials shall be new.

D. Equipment shall be essentially the standard cataloged product of manufacturers regularly engaged in production of such equipment and shall be manufacturer's latest design that complies with the specification requirements.

E. The Contractor shall obtain insurance company approval and all necessary approvals and permits from state and local authorities for the fire protection system and all its components, accessories, and related items.

1.06 CONTRACTOR QUALIFICATIONS

A. Prior to installation, the Contractor shall submit data for approval by United, showing that the Contractor has successfully installed automatic fire extinguishing sprinkler systems of the same type and design as specified herein or that he has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. The contractor shall indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.

1.07 GUARANTEES

A. Contractor shall guarantee all work and material for a period of two years from date of acceptance and shall:

a. Furnish guarantees for equipment.

b. Replace equipment that proves faulty or does not operate in accordance with specifications.

c. Replace damaged materials.

2.0 PRODUCTS

2.01 WET PIPE SPRINKLER SYSTEM

A. DESIGN

a. Design of wet pipe extinguishing sprinkler systems shall be by Pipe Schedule for Extra Hazard (Group 1) for the entire facility and shall conform to NFPA 13 and to the requirements as specified herein.

b. The east section wet pipe sprinkler system consists of the area from column line 5' to column line 11 and will be fed from an 8" riser on the east side of the building. This section shall have a design water flow of 0.30 gpm/s.f. over a 3,000 s.f. area and 500 gpm for hose streams over the hydraulically most remote area.

c. The west section wet pipe foam-water sprinkler system consists of two rooms from column line 1 to column line 5 and will be fed from an 8" riser into the fire protection room near column C-1. This section shall also have a design water flow of 0.30 gpm/s.f. over a 3,000 s.f. area and 500 gpm for hose streams over the hydraulically most remote area.

d. Provisions shall be made to route fire water test discharges to the outside of the facility located as directed by United.

e. All materials and equipment provided shall comply with referenced NFPA standards and shall be UL listed and FM approved.

f. Sprinklers shall be installed beneath ducts and other obstructions over 4 ft. wide unless ceiling sprinklers can be spaced in accordance with Table 4-2.4.6 of NFPA 13.

g. Hydraulic Calculations: For bidding purposes, calculations for sprinkler piping shall be based on a static pressure of 100 pounds per square inch gage. All final calculations shall be based on flow data derived from actual hydrant flow tests, performed by this Contractor, at existing hydrants in the vicinity of the control building. Hydrant test shall be coordinated with the P&W Fire Department for schedules and witnesses.

h. The alarm check valves shall be installed in accordance with Pratt & Whitney Engineering Standard PLES 129-01, a copy of which is attached to this Section.

B. ALARMS

a. Fusible links in sprinkler heads shall actuate fire water flow from the sprinklers. Sprinklers in both systems shall use 286°F rated heads. Flow from any one head shall actuate the check valve alarms in each system.

b. Manual pull stations shall be provided as shown on drawings.

C. ABOVEGROUND PIPING SYSTEMS

a. Pipe and Fittings:

- All aboveground water and foam-water sprinkler piping shall be schedule 40 steel. Inspect, test and obtain approval of piping before covering or concealing. Make changes in piping sizes through tapered pipe fittings; the use of bushings will not be permitted.

- Fittings into which sprinkler, sprinkler head riser nipples, or drop nipples are installed shall be threaded. Use of plain end fittings with mechanical couplings (which utilize steel gripping devices to bite into the pipe when pressure is applied) will not be permitted. Rubber gasketed grooved-end pipe and fittings shall be permitted in pipe sizes 4 inches and larger. Rubber gaskets shall be UL listed, BUNA-N for the foam-water sprinkler system. Provide long radius fittings for changes in direction of piping 4 inches and larger.

- Furnish and install piping straight, plumb, and as direct as possible. Form right angles on parallel lines with building walls. Keep pipes close to walls, partitions, ceilings, offset only where necessary to follow walls, as indicated. Piping shall be accurately cut to measurements established in field and worked into place without springing or forcing. All piping shall be reamed to be free of burrs after cuttings. Keep piping free from scale and dirt. Protect open pipe ends whenever construction work is suspended to prevent foreign bodies entering and lodging there. Use temporary plug, or other approved material for protection.

- Screwed Joints: All pipe and fittings with screwed ends shall have I.P.S. thread cut clean and true in conformance with ANSI Specification B2.2 for taper threads. Fittings shall be screwed up close to shoulders of male threads. All screwed pipe joints, except where specified otherwise, shall be made up with polytetrafluoroethylene (PTFE) pipe thread tape, applied to male threads only.
- Groove Joints: Pipe joints with mechanical grooved couplings shall be joined by an approved combination of couplings, gaskets and grooves. Grooves shall be dimensionally compatible with the couplings.

b. Pipe hangers shall be provided in accordance with NFPA 13.

c. Valves shall be provided as required by NFPA 13 and approved for fire service. Gate valves shall be flanged, clear opening in a counter clockwise rotation. Check valves shall be swing check type with flanged inspection and access cover plate for sizes 4 inches and larger.

d. Identification signs shall be properly lettered approved metal signs conforming to NFPA 13. Signs shall be attached to each valve and alarm device. Permanently affix hydraulic design data nameplates to the riser of each system. Valve numbers shall be as determined by Pratt & Whitney Fire Department.

e. Inspector's test connections shall be provided for each sprinkler system in accordance with NFPA 13. Test connections shall be located at the hydraulically most remote part of each system. Provide test connection piping so that water may be discharged outside in a safe manner.

f. Drains: Provide drain piping to discharge at safe points outside the building. Provide auxiliary drains as required by NFPA 13.

g. Pipe Sleeves: Provide where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25-inch space between exterior of piping or pipe insulation and interior of sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal.

- Sleeves in Masonry and Concrete Walls and Floors: Provide Schedule 40 steel pipe sleeves. Extend sleeves in floor slabs 6 inches above the finished floor.

- Sleeves in Partitions and Other Than Masonry and Concrete Walls, Floor, and Roofs: Provide zinc-coated steel sheet having a nominal weight or not less than 0.90 pounds per square foot.

h. Escutcheon Plates: Provide one piece or split hinge type metal plates for piping passing through floors, walls, and ceilings in exposed areas. Provide paint finish on plates. Securely anchor plates in place with set screws or other approved positive means.

D. EQUIPMENT

a. Provide variable pressure type alarm valves complete with retarding chamber, alarm test valve, alarm shutoff valve, drain valve, pressure gages, accessories and appurtenances necessary for the proper operation of both systems.

b. Provide pressure switches of double contact type with circuit openers or closers for the automatic transmittal of an alarm over the facility fire alarm system and connect into the fire alarm system. Install the switches in the alarm valve trim ahead of all valves and retard chamber so that the switches cannot be shut off.

c. Additional pressure switches shall be provided in each fire water riser to handle the following functions:

1. Foam-water riser to start foam-water pump, close fire doors, and shut down air circulation fans.

2. Water only riser to close fire doors and to shut down air circulating fans.

2.02 FOAM-WATER SYSTEM

A. DESIGN

a. The west end of the Waste Storage Facility (between column lines 1 and 5) shall be provided with a wet pipe foam-water sprinkler system as described herein and in Section 2.01 above.

b. The foam concentrate to be employed shall be National Foam System, Inc., Ultra 3 Polar solvent/hydrocarbon, or approved equal.

c. The foam concentrate shall be diluted with water to three percent by volume using a foam concentrate pump and an in-line balanced pressure proportioner, just before it is supplied to the sprinkler manifold system.

d. One vertical polyethylene atmospheric liquid storage tank shall be provided. This tank shall supply concentrate through an auxiliary pump to a single in-line balanced pressure proportioner with the resulting foam-water solution being distributed throughout the foam-water wet pipe sprinkler manifold system. The tank, alarm valve, pump and proportioning module shall be located in the fire protection room.

e. In general, the system shall be as described in NFPA-11, Appendix A, Section A-1-4(F).

g. All materials and equipment provided shall comply with reference NFPA standards and shall be UL listed and FM approved as indicated.

B. FOAM CONCENTRATE TANK

a. The system shall consist of one tank to be located in the fire protection room.

b. One 550-gallon vertical Polyethylene atmospheric foam concentrate storage tank shall be provided. The tank shall have a nominal diameter of 4'-0" and an overall length of 6'-6" (not including fill connection).

c. The tank shall be designed to meet ASTM standards for impact test, density, tensile strength, elongation, high and low temperature and flexural modulus. Tank shall be suitable for use at temperatures from -20°F(-29°C) to +150°F(66°C).]

d. The tank shall be provided with connections for venting and draining as well as 2-1/2" NPT connections for suction and return.

e. Tank shall be provided with 1-1/2" fill connection with cap and funnel.

f. Tank shall have a flat bottom and shall be located on a flat, level surface.

g. Tank shall be provided with lifting lugs.

h. A sufficient quantity of foam concentrate shall be furnished to conduct field acceptance tests, completely fill sprinkler system piping with solution and completely fill storage tank. Provisions should be made so that a reserve supply of foam concentrate could be made available within 24 hours.

i. Tank shall be provided with a tank level indicator which will send a signal indicating low level.

C. FOAM CONCENTRATE/WATER PROPORTIONING SYSTEM

a. An in-line balanced pressure proportioner shall be provided to proportion the foam concentrate and water streams to produce a solution consisting of 3 gallons of foam concentrate to 97 gallons of water.

b. The proportioner shall be located downstream of the alarm valve with a minimum of 5 pipe diameters straight and unobstructed pipe between them.

c. A foam pump is required to supply foam concentrate to the water stream at a pressure 30 psi greater than the water pressure.

d. A check valve shall be provided in the foam concentrate line to prevent back-flow of fire water.

e. Foam concentrate piping, fittings and couplings shall be constructed of brass.

f. Valves and check valves: All block valves in the foam concentrate piping system shall be of the OS & Y type. Check valves shall be of the clear opening swing check type and shall incorporate a screwed or flanged inspection and access opening. Valves and check valves shall be of the flanged or threaded types and shall be brass or stainless steel 304. All valves shall be approved for fire service.

g. A 1" foam sampling connection shall be installed in the wet-pipe foam-water riser between the proportioning system and the downstream OS & Y valve. A 1" water only test connection shall be installed in the fire water riser between the alarm valve and the proportioning system.

D. FOAM CONCENTRATE PUMP AND CONTROLLER

a. Foam concentrate pump installation shall conform to the requirements of NFPA-20. Pump shall be a positive displacement, rotary type, heavy duty, iron fitted construction and with a capacity adequate to meet the specified volume requirements, plus 25%, and a discharge pressure of 30 psig higher than the highest expected water pressure. Pump shall be driven by an electric motor conforming to the specified requirements. All components shall be mounted on a common steel base. Relief valve shall be furnished with pump and motor assembly. Pump base shall be mounted on a concrete equipment pad as shown on Drawings.

b. Pump shall be started using a pressure switch mounted to water riser in conjunction with a limited service controller. Controller shall conform to the latest edition of NFPA-20 and NFPA-70 and as specified on the Drawings.

2.03 HOSE CABINETS AND APPURTENANCES

Hose cabinets shall be installed where shown on drawings. Deviations from equipment specified below shall require approval from P&W Fire Department.

A. WATER ONLY HOSE EQUIPMENT

a. Metal hose cabinet shall be surface mounted Allenco CRL hose cabinet, Model 478L, with capacity for 150 ft. of single jacket, rubber lined fire hose.

b. Hose cabinet valve shall be Allenco Model 170U, 1-1/2 in., brass angle valve. Valve shall have a female end with iron pipe thread and male end with National Standard hose thread. Valve shall be located inside hose cabinet.

c. Fire hose shall be single jacket 1-1/2 in. fire hose, rubber lined, woven, coupled in lengths of 50 ft., long bowl couplings with heavy duty triple rocker lugs and National Standard hose thread. National Fire Hose No. 44-AP5 or Good all Dri-Rack No. F-93 shall be used. Aluminum alloy couplings shall be of 6061-T6 metal, extruded, seamless and molykoted. Red Head coupling No. 8815 is acceptable. Water repellant, mildew and rot prevention treatment of wax and gum solution to be added to hose with cotton fibres. Finished hose to be tested at 300 psi.

d. Nozzle shall be 1-1/2 in. mystery nozzle Lexan Model HN-4L with National Standard hose thread (Allenco No. 8112).

e. A quantity of 2 spanner wrenches of Universal type Model No. 10 or T-464 or equal shall be supplied (Allenco No. 37).

B. FOAM-WATER HOSE EQUIPMENT

a. Foam-water feed to hose reel shall be a 2-1/2 in. pipe reducing to a 1-1/2 in. at the hose reel.

b. Hose reel shall be continuous flow wall red Wirtknox FD-47-1-1/2-100 with a capacity of 100 ft. of 1-1/2 in. non-collapsable hard rubber hose.

c. Hose valve shall be as specified in 2.03-A.b. above.

d. Fire hose shall be non-collapsible hard rubber with brass expansion ring couplings, National Standard Hose Thread. Hose shall have a red cover and oil resistant tube and shall be pressure tested at 250 psi, 100 ft. of 1-1/2 in. hose shall be supplied.

e. Nozzle shall be National Foam JS-10 with pistol grip shut-off and 1-1/2 in. National Standard Hose Threads.

2.04 CONTROL PANEL

A. Remote data gathering panels shall be microprocessor controlled and shall provide alarm device monitoring and remote control capabilities for alarm sounding devices and fire related equipment. Panels shall be designed for use in an industrial environment. Consideration should be given to providing the necessary filtering, E.M.I. and R.F.I. plus regulation required to cope with the industrial power environment.

B. Panel shall be of dead front construction, utilizing plug-in circuit boards or modules. Panel shall monitor standby battery charging current and voltage, main DC power supply voltage and current, display shall be via L.E.D. readout. System trouble warning shall be activated upon loss of primary or standby power. Each initiating circuit shall be equipped to indicate via L.E.D. or other suitable device an alarm or trouble condition on its inputs. Silencing alarm at panel shall not cancel signal to computer. Computer shall record alarm or trouble as long as condition exists at panel. all field wiring shall be electrically supervised and a single open or ground-fault condition does not prevent alarm initiation by any device connected to the circuit. Panel quality standard Kidde KDR 1000, (no equivalent).

C. KDR-1000 panel shall be installed in NEMA-12 enclosure. United shall have final approval for type and location of panels.

D. Panel shall be protected from physical damage by being installed in a protected location or via the installation of pipe railing guards. Location and protective precautions are subject to approval.

E. All conduit shall be sealed at point of entry into NEMA-12 enclosure to prevent entry of water, oil, etc.

F. NEMA-12 enclosure shall have key type padlock.

G. KDR-1000 panel shall have tamper switch installed. Switch shall be connected to panel trouble alarm and cause signal to be transmitted when door is open.

H. Panel shall have an AC/DC power disconnect switch installed inside of panel.

I. Monitoring panel shall be configured to support thirty-two (32) class "A" input zones and eight (8) output zones. Panel shall have a minimum of 20% spare capacity. Modules to be AIZ-AWZD-ARM-BOZ.

J. KDR-1000 panel shall consist of:

1 PCP with DMM module and four blank modules. PCP shall be modified to meet insurance requirements.

4 IZP's with 8 modules each

Provide 16 AIZ

Provide 8 AWZD

Provide 8 Blank

1 OZP-2's with three BOZ and five blank modules

1 MIP board (new type)

1 Battery cabinet with two 12 volt 25 amp/hr batteries or as required

K. Each panel load shall be calculated by using Table 3-1 (worksheet format for calculating PCP load) found in KDR-1000 System Manual. A copy of this worksheet must be supplied for each panel.

L. All input zones shall be wired Class "A" using an AIZ module. Each input module shall be provided with a toggle switch to disconnect wiring from system. Actuation of this switch to the off normal position shall cause a trouble indication at the panel and also at the control processor. The trouble indication to the control processor must remain until the switch is returned to normal.

M. Input zones to waterflow modules shall be wired Class "A" and supervised. The module shall be an AWZD containing a built-in 0 to 90 second adjustable time delay.

N. Alarm signal must be manually reset at initiating device, pull box or detector panel. Resetting of KDR panels must be done at the panel. The alarm conditions once detected shall be locked in. System reset must be physically accomplished at the KDR panel.

O. Sounding of alarm horns in the Brigade Call-Up format shall be through relay actuation in the KDR panel under control of the main processing system Brigade Call-Up software. United to determine requirements of Brigade Call-Up.

2.05 ALARM AND CONTROL DEVICES

A. Contractor shall tabulate all initiating and control devices to be furnished and installed. Tabulations shall be based on the system requirements. Contractor shall verify exact location of points to be monitored and assure that all points required and method of monitoring be consistent with the requirements of Factory Mutual Bulletin 5-40 Class 6A system. Contractor shall provide tabulated listings of all points, summarized tables of each category of devices and monitoring requirements.

B. Valve Supervisory Switches:

a. Valve supervisory switches shall monitoring sprinkler protection and all other fire protection valves larger than 2 inches. Removal of the switch or cover shall activate the trouble signal. Contractor to provide, install and wire all supervisory switches. Weatherproof or waterproof switches to be provided as required. Valve supervision shall annunciate two (2) signals, one is alarm when valve is not fully open and second signal when the valve is restored to full open position. For PIV valve switch shall be Potter PCVS and for OS&Y valves the switches shall be Potter OSYSU-A2, all with Form C contacts.

b. More than one (1) valve may be supervised on a Class "A" circuit if the valves are part of the same sprinkler system or if they are divisional valves at the same location. More than one (1) on a circuit require P&W Fire Department approval.

c. Valve supervisory switches shall have dual open contacts. Products by Kidde, Potter, Notifier or Grinnell are acceptable. Valves smaller than 2-1/2 inches may require additional mounting hardware.

C. Water Flow Switches

Water flow switches shall be furnished and installed as required. New and existing water flow switches shall each report as a separate point. Vane type flow switches not acceptable as riser alarms. (exception) When used to indicate water flow in portion of system with United approval. All flow switches to have two (2) sets of contacts. Vane and riser flow switch may use same circuit.

D. Manual Pull Station: Non-coded type with mechanical reset features. Station shall be semi-flushed style and shall be installed in cast surface-mounted box. All wiring connections shall be screwed terminals. Break glass front station is not permitted. Station exposed on the exterior of the building shall be weatherproof type.

E. Air Duct Smoke Detectors

1. Duct system smoke detectors shall be installed in the locations shown on HVAC sheets of the Contract Drawings.

2. Smoke detection equipment specified herein shall be ionization smoke detector model No. DI-B3 and self contained air duct housing model No. SA-3I as manufactured by Cerberus Pyrotronics, 8 Ridgedale Avenue, Cedar Knolls, NJ 07927.

3. Sampling tubes shall be provided for each unit and shall be the proper size for the specific duct installation.

4. Smoke detection equipment shall be designed to close air circulating systems upon detection of smoke in the ventilation ducts.

5. Smoke detection equipment shall be UL listed and shall comply with the requirements of NFPA 90A and NFPA72E.

6. Wiring of smoke detection equipment shall be as shown in the electrical section of the Contract Drawings and shall conform to the requirements of Specifications Section 16400; Electrical Work.

2.07 ELECTRICAL

A. Primary Power: Power shall be 120 volt AC service, transformed through a two winding isolation type transformer and rectified to 24 volts DC for operation of all signal initiating, a signal sounding and trouble signal tripping circuits. An auxiliary DC power supply for operation of a system in the event of failure of the AC supply shall be provided. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and shall not cause transmission of a false alarm. Loss of AC power shall not prevent transmission of a signal to station fire alarm headquarters upon operation of any signal initiating circuit. AC operating power shall be obtained from the line side of incoming power source ahead of all other services. An independent properly fused safety switch with provisions for locking the cover and operating handle in the "POWER ON" position shall be suitably identified by a permanently engraved lettered designation.

B. Auxiliary Power: Consists of sealed lead calcium or nickel cadmium rechargeable storage batteries and battery charger.

C. Wiring: Shall be in accordance with the requirements of NFPA 70, 72B, 72D, and 72E. Wire for 120V circuits shall be No. 12 AWG minimum. Wire for low voltage DC circuits shall be No. 18 AWG minimum single solid copper wire. All wiring shall be color coded. All wiring shall be in conduit of electrical metallic tubing. All circuit conductors shall be identified within each enclosure where a tap, splice, or termination is made. Conductor

identification shall be by plastic coated self-sticking printed markers or by heatshrink type sleeves. The marker shall be attached in a manner that will not permit accidental detachment. Control circuit terminations shall be properly identified. No "T" wiring or pigtail connections shall be permitted. Field wiring shall be as specified in Section 16400.

D. Control panel storage battery charger shall be provided. charger shall have completely automatic high/low charging rate and shall be capable of recharging the batteries from full discharge to full charge in 24 hours or less. Ammeter for recording rate of charge and volt meter to indicate the state of battery charge shall be provided. Red pilot light to indicate when batteries are manually placed on a high rate of charge shall be provided. Charger shall be located in control panel or battery cabinet.

3.0 EXECUTION

3.01 INSTALLATION

A. Equipment, materials, installation, and workmanship shall be in accordance with all applicable NFPA standards, except as modified herein. Install piping straight and true to bear evenly on hangers. Keep the interior and ends of new piping and existing piping affected by the Contractor's operations thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping and fittings so that water and foreign matter will not enter the pipes or fittings. Inspect piping before closing open ends.

3.02 INSPECTION, TESTING AND FLUSHING

A. General: The Contractor shall perform the pressure tests of his piping and shall closely inspect his work. The Contractor shall test and adjust all equipment, controls and devices to make certain the foam system is complete and in condition for automatic operation. The Contractor shall furnish all gauges, instruments, test equipment and personnel required for tests, make all provisions for removal of test equipment and draining and flushing of piping as necessary after tests have been completed. The manufacturer's technical representative shall supervise preliminary and final tests.

a. Tests may be made of isolated portions of such piping as will facilitate general progress of the installation. Any subsequent changes made to approved piping will require retesting of such affected portions of the work.

b. Routine tests made prior to final tests may be witnessed by, and subject to approval of, United. Final (acceptance) tests shall demonstrate the functions and capability of the foam systems, including, and while working in conjunction with , the wet-pipe sprinkler systems. Final tests shall be witnessed by and subject to the approval of the P&W Fire Department.

c. United shall be notified by the Contractor not less than 20 days in advance of routine tests made during the installation of the Foam System.

d. United shall be notified in writing by the Contractor under this section, not less than twenty (20) days in advance of final tests.

B. Test Procedures: Initially, all work shall be inspected for completion and conformance to applicable drawings. Testing procedures and methods, instruments employed and test report forms, shall be approved by United.

a. Piping shall be hydrostatically tested, at not less than 200 psig for two consecutive hours with no leakage. Underground piping shall be pressure tested and approved before joints have been coated and wrapped or concealed by backfilling. Piping subject to hydrostatic testing shall be free of trapped air when pressurized. Sources of pressure shall be disconnected from piping undergoing testing, after test pressure has been attained.

b. Operating tests shall be performed in the presence of the P&W Fire Department on all systems. Tests shall be sufficient in number to ascertain all foam producing devices will operate at design pressure and design foam solution concentration, and to observe operating characteristics. Complete full flow tests shall be required at the maximum system discharge for a maximum of three minutes, to ensure that all systems will properly function under maximum conditions, utilizing water, foam, alarms, and manual system in all appropriate combinations of operations. During the test, foam samples shall be obtained from the sprinkler spray systems, monitors and storage tank foam chamber and inlets. The samples shall be analyzed for expansion, and form solution concentration by the methods outlined in NFPA 11.

C. Contractor shall perform all testing and flushing in accordance with NFPA standards and applicable insurance company standards.

D. Contractor shall make tests of his work as required by United during this progress of work to demonstrate strength, durability and fitness of installation.

E. Duration of tests shall be such that United can make thorough inspection.

F. Hydrostatic Test: Maintain test pressure by means of small pump, with main controlling gate shut to avoid serious water damage in event of a break, while testing underground section.

G. Flush piping in accordance with NFPA 13. Test the alarms and other devices. Test the water flow alarm by flowing water through the inspector's test connection. When tests have been completed and corrections made, submit a signed and dated certificate, similar to that specified in NFPA 13, with a request for a formal inspection and tests.

H. An experienced technician regularly employed by the sprinkler installer shall be present during the inspection. AT this inspection, repeat any or all of the required tests as directed. Correct defects in the work and make additional tests until it has been demonstrated that the systems comply with all contract requirements

I. Submit evidence of approval by insuring agency for work under this section, prior to acceptance of work by United.

3.03 CHARTS AND SPARE SPRINKLERS

A. Provide glass-mounted instructions charts on wall near valves, with description of operation of system and maintenance procedures.

B. Provide spare sprinklers and sprinkler wrench in accordance with NFPA 13.

3.04 IDENTIFICATION

A. Identify control, drain and test-alarm valves with identification tags of type approved by NFPA. Securely wire same to valve system.

END OF SECTION

See Attached PLES 129-01

TYPICAL ALARM CHECK VALVE INSTALLATION - FIRE PROTECTION SPRINKLER SYSTEMS

1.0 PURPOSE

1.1 To provide a uniform standard for the inclusion of alarm check valves for all automatic sprinkler systems.

2.0 SCOPE

2.1 Alarm check valves with water motor gongs and electrical connection to Pratt & Whitney Fire Headquarters must be provided for all new automatic sprinkler systems and existing systems when and where they are taken out of service for design changes or other extensive alterations.

3.0 COMPONENTS

3.1 Type numbers refer to Plant Engineering Supplies Catalog Specifications.

3.1.1 Alarm check Valve (Type 3932-88 complete with Retarding Chamber, Local Alarm, Electrical Water Alarm Switch with pneumatic time delay.

3.1.2 Piping Schedule 40, black steel, ASTM A120, (Type 3629-35) and ASTM A53 (Type 3638-35).

3.1.3 Main Line Flanges class 150, ANSI B16.5 malleable iron, slip-on welding or threaded flanges.

3.1.4 Valves
a) Valves, Kennedy Fig 97 or 98.
b) Gate valve (Type 3957-05.

3.1.5 Pressure Gauges 0-300 psig (Type 3384-44, stock number 338416216).

3.1.6 Valve tamper switch, two (2) sets of Form C contacts.

3.1.7 All components shall be UL listed and/or FM approved.

4.0 INSTALLATION

4.1 All lines drainable in accordance with NFPA No. 13, section 3-11 (Drainage).

4.2 Check valve installation should be provided with 4-foot clear area on all sides of riser wherever possible.

4.3 Gate valves shall be installed so its stem is parallel to the wall.

4.4 Gate valves, alarm check valves, and mechanical trimmings shall be painted P&W red.

4.5 Protective pipe railing shall be installed in such a manner to insure that the control valve is readily accessible.

5.0 OPERATION

5.1 Alarm Check Valve. When a sprinkler opens, the pressure in the system is relieved raising the alarm check valve clapper. This permits water flow through the seat channel to the retarding chamber.

TYPICAL ALARM CHECK VALVE INSTALLATION - FIRE PROTECTION SPRINKLER SYSTEMS
(Cont'd)

5.2 Retarding Chamber. The flexible diaphragm of the retarding chamber is forced downward when chamber fills; this, acting through rocker arm, closes valve preventing escape of water through drip pipe. Spring forces diaphragm up which returns valve to open position when retarding chamber is emptied.

5.3 Water Flow Alarm Switch shall be installed upstream of the alarm shutoff valve. Switch shall have two (2) sets of Form C contacts.

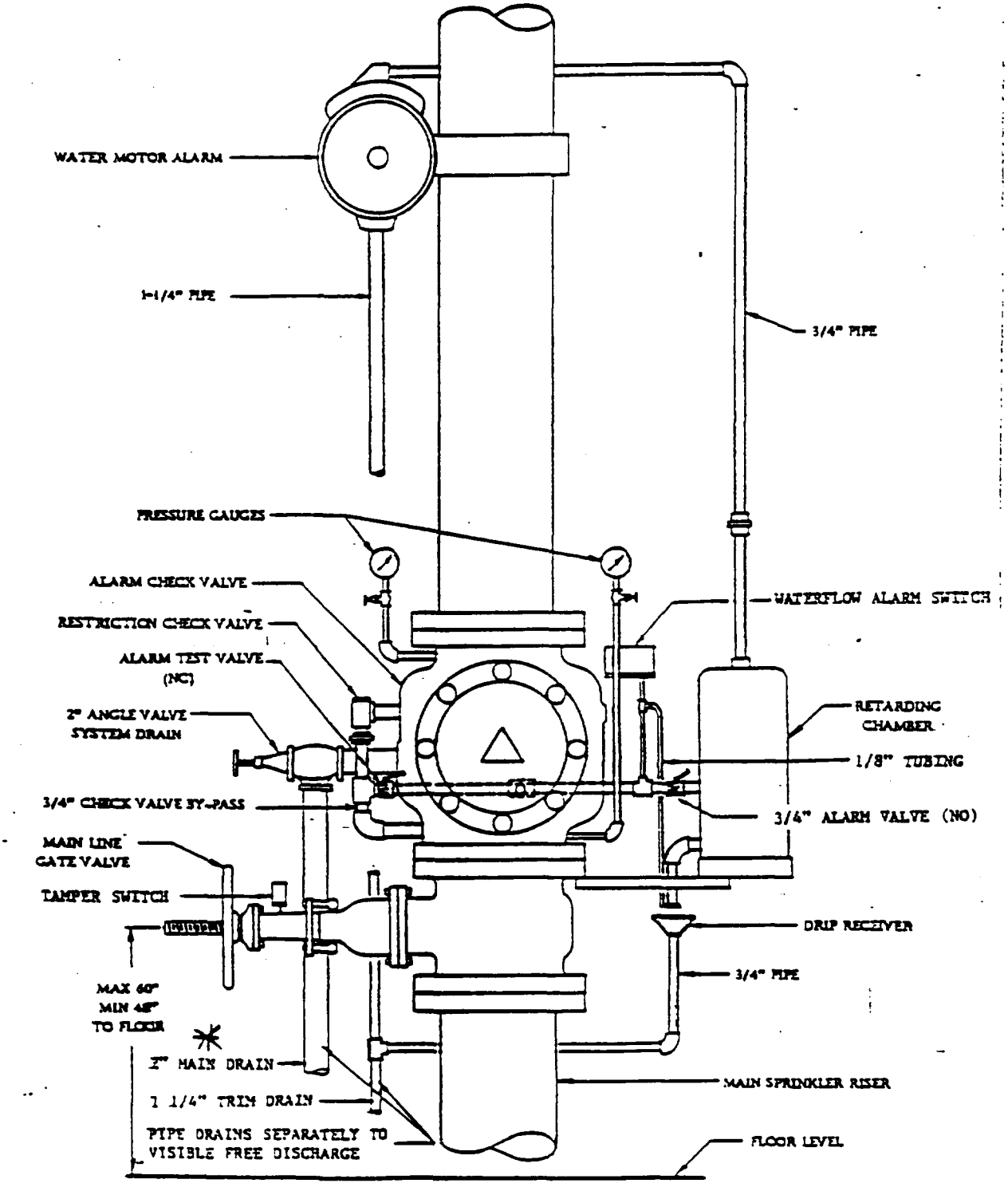
5.4 Local Alarm. Upon operation of the alarm, dry pipe or deluge type valve to which the water motor alarm is connected, water flows through the alarm piping to the water motor gong through the 3/4 inch inlet connection and the restriction nozzle. The force of the water flowing causes the impeller and the striker assembly to rotate in a clockwise direction. With each rotation of the striker arm the free swinging striker ring strikes the gong, sounding a loud alarm. During operation, water drains from the water motor body through the 1-1/4 inch drain connection and drain piping.

6.0 TESTING

6.1 Alarms may be tested by opening the inspector's test valve. By using the test valve, electric alarm switch and water motor alarm can be tested without disturbing the alarm check valve clapper.

NOTE: See typical installation page 3.

TYPICAL ALARM CHECK VALVE INSTALLATION - FIRE PROTECTION SPRINKLER SYSTEMS (Cont'd)



DIVISION 15 - MECHANICAL

SECTION 15600 - HEATING AND VENTILATION

1. GENERAL

1.01 SCOPE

A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and other Division 1 Specification sections, apply to work specified in this section.

B. The work of this Section includes all labor, materials, and equipment required to complete the heating and ventilating systems as herein specified, including but not necessarily limited to the following:

1. Air handlers and related piping, ductwork, louvers and appurtenances.

2. Exhaust, roof and vent fans, including appropriate ductwork, ductwork louvers, and related appurtenances.

1.02 STANDARDS

A. Equipment and component parts thereof shall bear manufacturer's nameplate, giving manufacturer's name, size, type and model number or serial number to facilitate maintenance and replacements. Nameplates of distributors or contractors are not acceptable.

B. Materials and accessories shall be constructed in accordance with latest ASTM standards. Equipment and materials shall be new.

C. AMCA Compliance: Fans shall bear the Air Movement and Control Association, Inc. (AMCA) Certified Ratings Seal. Test and rate unit fans in accordance with AMCA Standard 210 (ASHRAE Standard 51).

D. UL and NEMA Compliance: Provide electrical components which have been listed and labeled by Underwriters' Laboratories (UL) and comply with NEMA Standards.

E. ARI Compliance: Test and rate air handling units in accordance with ARI 430 "Standard for Central-Station Air Handling Units", display certification symbol on units of certified models.

F. NFPA Compliance: Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50. All equipment shall comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

G. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of air handling units.

H. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards - Metal and Flexible" for fabrication and installation of sheet metal ducktwork. Comply with SMACNA "PVC Duct Construction Standards" for fabrication and installation of PVC ductwork.

I. Industrial Ventilation: Comply with "Industrial Ventilation - A Manual of Recommended Practice" by the Committee on Industrial Ventilation, American Conference of Governmental Industrial Hygienists, Inc.

J. Equipment shall be essentially the standard cataloged product of manufacturers regularly engaged in production of such equipment and shall be manufacturer's latest design that complies with the specification requirements.

K. Couplings, keys, and other moving parts located so that any person can come in close proximity thereto shall be fully enclosed or properly guarded.

L. All current OSHA requirements shall be followed.

1.04 RELATED WORK SPECIFIED ELSEWHERE

Work required for providing piping, electrical work, instrumentation, finish painting, and related work shall be as specified elsewhere. Coordination shall be done to insure that all related items of work are provided as specified. Steam and condensate piping, valves and specialties shall be as specified in Section 15610.

1.05 SUBMITTALS

A. Shop drawing submittals shall be in accordance with Section 01300, submittals.

2. PRODUCTS

2.01 GENERAL REQUIREMENTS

A. The equipment supplied under this specification shall be equal to that specified. Substitutions must be approved by United.

2.02 AIR HANDLERS

Furnish and install air handling units as shown and scheduled on the plans. The units shall be installed in strict accordance with the specifications. All units shall be complete with fan section, coil section filter section and all accessories specified.

Unit shall be constructed of a complete frame with removable panels. Removal of side panels must not affect the structural integrity of each module. All exterior wall panels shall be made of galvanized steel. Closed cell foam gasketing shall be applied where modules are joined.

Full sized double wall access doors with safety handles shall be provided for quick access to the interior of the unit casing. Doors attached by screws or doors not continuously gasketed are not acceptable. Unit shall be factory insulated with one-inch, 3/4-pound density matt-faced insulation.

Filters shall be of the throwaway type and shall have 2-inch thick fiberglass media contained in a rigid frame. Filters shall have a rigid supporting maze across both the entering and leaving faces of the media. Filters shall be sized so as not to exceed scheduled face velocities.

Fans shall be double width, double inlet, multiblade type as manufactured by the unit manufacturer. Fans shall be forward curve (FC).

Supply fan performance shall be certified as complying with ARI Standard 430. Centrifugal fans shall be dynamically balanced at the factory as a complete fan assembly (fan wheel, motor, drive and belts). Fan shafts shall not pass through their first critical speed at any cataloged rpm.

Fans shall be equipped with self-aligning, anti-friction pillow block bearings with a minimum life of L-50 200,000 hours. Bearings shall be equipped with grease lines allowing for lubrication from the motor side of the fan.

Fan and motor assembly to be internally isolated from unit casing with rubber-in-shear isolators, furnished and installed by unit manufacturer.

Motors shall be mounted integral to an isolated fan assembly furnished by the unit manufacturer. Motors shall be mounted inside the unit casing. Motor mounts shall be adjustable to permit drive belt tensioning. Motors shall be 460 volt/60/3 "T" frame.

Drives shall be variable pitch, suitable for adjustment within five percent of specified rpm.

2.03 EXHAUST FANS

Exhaust fans EF-1A, 1B, 2A, 2B, 3A, 3B, 4A and 4B shall be duct axial type for roof mounting as scheduled on the drawings as manufactured by Hartzell Fan, Inc. The fans shall be complete with roof mounting hardware and fabricated roof curb for installation on the sloped roof. Back drafts dampers shall be provided.

Exhaust fans EF-1A, 1B, 2A and 2B, in Rooms 1 and 2, shall be Series 46 with carbon steel housing and aluminum propeller. These fans shall be AMCA B rated spark resistant and all electrical equipment shall be rated for Class 1, Div. 1, Group D (explosion proof) environments.

Exhaust fans EF-3A, 3B, 4A and 4B, in Rooms 6 and 7, shall be Series 35 with fiberglass housing and resin coated propeller (EF-1A shall be provided with special lining for resistance to dilute hydrofluoric acid vapors). Shafts and other metal parts in contact with the air stream shall be Type 304 Stainless Steel (except EF-1 which shall be monel).

Exhaust fan EF-5 shall be centrifugal dome exhauster for roof mounting as scheduled on the drawings Type HDD as manufactured by Hartzell Fan, Inc. Fan shall be provided with birdscreen, backdraft damper and 12" roof mounting curb for installation on the sloped roof.

Fans shall be tested to AMCA test Code 210 for air performance.

2.04 ROOF FANS

Roof fans shall be upblast type for roof mounting as scheduled on the drawings as manufactured by Hartzell Fan, Inc. The fans shall be complete with roof mounting hardware and pre-fabricated roof curb for installation on the sloped roof. Back draft dampers shall be provided.

Roof fans shall be Series 69 with carbon steel housing and aluminum propeller.

2.05 WALL LOUVERS

Furnish and install air intake louvers as shown and scheduled on the drawings. The louvers shall be equal to the Ruskin models specified. The louvers shall be equipped with 1/4 inch bird screen, interior mounted. Louvers shall be provided with Kynar finish from manufacturers standard colors to be selected by United. Motorized louvers in Rooms 1 and 2 shall be provided with electrical equipment rated for Class 1, Div. 1, Group D (explosion proof) environments.

2.06 UNIT HEATERS

A. General: Provide unit heaters in locations as indicated, and of capacities, style, and having accessories as scheduled. Heaters shall be Modine Model SDH 296 door heaters.

B. Unit Heaters

1. Casing: Construct of steel, phosphatized inside and out, and finished with baked enamel. Design casing to enclose fan, motor, and coil, design fan orifice formed into discharge panel. Provide adjustable air diffuser for each heater. Specifically configured for heating overhead doors.

2. Fans: Construct of aluminum and factory-balance. Design so motor and fan assembly is removable through fan outlet panel.

3. Coils: Construct of plate-type aluminum fins, mechanically bonded to copper tubes. Design coil for use in steam applications.

4. Motors: Provide totally enclosed motors, having electrical characteristics as scheduled.

2.07 FINNED TUBE RADIATION

A. General: Provide finned tube radiation of lengths and in locations as indicated, and of capacities, style, and having accessories as scheduled.

B. Cabinets: Minimum 18 ga. cold-rolled steel full backplate, minimum 16 ga. front with stamped "Pencil-Proof" louvers. Brace and reinforce front minimum of 4'-0" o.c. without visible fasteners.

C. Elements: Steel tube and fins.

D. Finish: Flat black heat resisting paint for backplate, factory finished baked enamel, standard collars, on fronts and accessories. Submit color chart with submittal for selection by Architect/Engineer.

E. Accessories:

1. End panels, inside and outside corners, and enclosure extensions, as required.

2. Access doors in front of valves and balancing cocks.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering finned tube radiation which may be incorporated in the work include, but are not limited to, the following:

1. Sterling Radiator, Div. of Reed National Corp.
2. Trane Co.
3. Vulcan Radiator Co.
4. Airtherm Mfg. Co.

2.08 AIR CONDITIONER

Packaged terminal air conditioner for the control room shall be as scheduled on the drawings. Air conditioner shall be Model 52EQ A5123 as manufactured by Carrier. Unit shall be rated in accordance with ARI Standard 380-87 or 310-87 and certified by UL and CSA.

The unit shall be complete with all controls, wiring, filters, architectural grille, drain, sub base and wall sleeve.

2.09 THERMOSTATS AND CONTROLS

A. Air Handlers: Air handlers shall run continuously to heat and ventilate Rooms 1, 2, 6 and 7. Room temperature shall be controlled by modulating a motorized control valve on the steam supply to each unit. A proportional temperature controller shall receive inputs from two sensors - room space temperature and discharge air duct temperature for each unit. The controller shall throttle the steam valve to maintain the room space set point temperature. Should the discharge duct air temperature drop below 55°F, the controller shall reset and open the motorized control valve. A low temperature stat shall also be provided in the discharge air duct to stop the air handler fan (and room exhaust fans) should the discharge air drop to 35°F for freeze protection. A contact shall be provided for connection of this switch to the fire alarm system. Air handlers (and exhaust fans) shall also stop if smoke is detected in the exhaust ductwork.

Controls shall be the following products as manufactured by Johnson Controls:

Controller: TC-6100 W/2 sensors-1 duct and 1 space (locate controller at air handler. Locate space sensor at 5' AFF).
Low Temp. Stat: A-11A.

Valve: VB-3754 (M130G.Motor) 1-1/2" (1" for AH-1)

B. Unit Heaters: Each unit heater fan shall be started from a separate thermostat provided by the manufacturer of the unit. The thermostat

shall also energize the solenoid valve on the steam supply. The thermostat must be installed above elevation 48.5 in Room 2.

C. Fin Tube Convectors: Room temperature in rooms with fin tube convectors shall be controlled by modulating steam flow with a thermostatic radiator valve. The valves shall be 1/2" brass with NPT end connections. Each valve shall be complete with remote sensor, mounting hardware and integral temperature setpoint adjustment. Valve shall be designed for tight steam shutoff.

2.10 DUCTWORK

A. Metal ductwork shall be used for all applications except exhaust ductwork in Rooms 6 and 7. All metal duct work, casing and supports shall be fabricated and installed in accordance with the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) Low Velocity Duct Construction Standards, 5th Edition, unless indicated otherwise on the drawings or specifications.

B. All duct sizes shown on drawings are net inside dimensions.

C. Duct work shall be constructed of galvanized sheet steel of U.S. Standard gauge in accordance with SMACNA "HVAC Duct Construction Standards for Metallic Ducts".

D. All dimensions are to casings or duct centerlines, outside edge of duct or casings, working points and flanged ends unless otherwise noted on drawing.

E. All bolts, studs, nuts, washers and fasteners shall be cadmium plated steel.

F. All edge slips shall be hammered down to leave a smooth interior duct finish. All seams and joints in duct system not exposed to weather shall be taped and made completely airtight. Ducts shall be anchored securely and the method of anchoring and/or fastening shall be detailed on the layout drawings. Ducts shall be so constructed and installed as to be completely free from vibration under all conditions of operation. Supports shall be attached only to structural framing members and concrete slabs, unless detailed on the drawings. Where supports are required between structural and framing members, suitable intermediate metal framing shall be provided and detailed.

G. Longitudinal seams in duct work shall be Pittsburgh Lock". Refer to SMACNA manual.

H. Transverse joints shall be 1" x 1" government clips securely fastened to the duct with clip notches hammered tight. Clips shall be well formed and tightly closed. For details, see SMACNA manual.

I. Standing seams and reinforcing angle shall be installed in accordance with SMACNA manual.

J. Duct sections shall not exceed 8'-0" in length.

K. Elbows, fittings, branch take-offs, transitions, splitters, and all other duct components shall conform to the SMACNA HVAC Duct Construction Standards subject to the following requirements:

1. Wherever space permits, elbows shall have a standard centerline radius equal to 1-1/2 times their width. Short radius and mitered elbows shall be used only where shown and where required to fit restricted spaces. Splitter vanes shall be fitted in short radius elbows of rectangular ducts and mitered to reduce loss to that of standard type; on leaving side of vane, provide a straight section equal in length to 1/3 of the duct dimension in plane of bend. Rectangular "square" (miter) elbows shall have double thickness turning vanes.

2. All round fittings shall have continuous welds along all joints.

3. Divided flow fittings (tees, crosses and laterals) are to be manufactured as separate fittings, not as tap collars welded into spiral duct sections.

4. Entrances into side outlets shall be radiused by machining, press forming, or grinding, and shall be without flow restrictions,such as projections, orifices, weld build-ups and burrs.

5. Where size of run exceeds 6 inches, outlets shall be of the conical type.

6. 90° round radius elbows shall be of the 5 piece type.

7. Round miter elbows shall be vaned type with number of vanes as follows:

Diameter	Number of Vanes
3" thru 9"	2
10" thru 14"	3
15" thru 19"	4
20" and over	5

8. The leading edge of vanes in ducts over 20" diameter shall be hemmed with 1/2-inch fold-back.

9. Turning vanes shall be reinforced by rods or sectional construction to limit unsupported length to 24 inches. Vanes shall be minimum No. 20 MS gage.

10. Spun bellmouth connections are to be used at each round take-off from plenums.

L. Dampers:

1. Manual Volume Dampers: Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards". Single blade dampers shall not exceed 6" in height. Multiblade dampers shall be opposed blade type.

2. Quadrant Locks: Provide for each damper a quadrant lock device on one end of the shaft, and bearing plate on the other end for damper lengths over 12 inches.

M. Manufactured Turning Vanes: Provide turning vanes constructed of double thickness curved blades, supported with bars perpendicular to blades set at 4" o.c., and set into side strips suitable for mounting in duct work.

N. Access Doors and Panels:

A. Access doors and panels shall be installed in casings, plenums and ducts where shown and wherever required for ready access to operating parts of any kind, including dampers and to provide access for cleaning coils and for removing louvers and screens from inside of building.

O. "Button Punch Snap Lock" duct construction shall not be permitted.

P. Hangers for ducts shall be installed in accordance with SMACNA manual or as shown on drawings. Strap or trapeze hangers may be utilized.

2.11 PVC EXHAUST DUCT WORK

A. PVC duct work shall be used for exhaust in Rooms 6 and 7. PVC exhaust ductwork shall be of rigid, unplasticized polyvinyl chloride (PVC) with heat welded joints. Ducts and accessories shall conform with the SMACNA Thermoplastic Duct (PVC) Construction Manual. Duct work shall be factory assembled in longest practical lengths, twenty (20) foot preferred.

All exhaust duct to be fabricated of Type II, Grade I, high impact PVC material conforming to ASTM D 1784-69 Cell 1433D. The following schedule of minimum gages and reinforcing will apply:

Max. Dia. (Round)	Gage	Reinforcing	Max. Side (Rectangular)	Gage	Reinforcing
22" dia.	1/8"	Per SMACNA	20" side	1/8"	Per SMACNA
36" dia.	3/16"	Per SMACNA	26" side	3/16"	Per SMACNA
60" dia.	1/4"	Per SMACNA	17" side	1/4"	Per SMACNA

B. FITTINGS - ROUND & RECTANGULAR DUCT

Flanges: To be made of PVC Type II angle material, heat formed and continuously back welded to duct section. 0 to 36" 1-1/2" x 1-1/2" x 3/16" angle. 37" and up 2" x 2" x 1/4" angle. Bolt holes to be 5/16" diameter for 1/4" stainless steel bolts and no more than four (4) inches apart on centers. Gasket material to be a corrosion resistant soft mastic type or PVC foam material. Full-face gasket materials are not acceptable for use with PVC. Provide flanged connections at the top of all vertical drops.

Sleeves: To be formed from four (4) inch wide flat Type I PVC material of a thickness equal to or greater than the wall thickness of duct to be joined. Weld to one end of duct section leaving one-half the sleeve length into which the adjoining section can slip.

Elbows: To have a minimum center line radius of 1-1/2 times diameter unless field conditions make it impossible. Ninety degree elbows to have five (5) gores and forty-five degree elbows to have three (3) gores.

Branches: To enter main at no more than forty-five degrees (thirty degrees preferred) to direction of flow and wherever practical to enter on an enlarging taper section. Branches should not enter opposite each other. B ranches to be continuously welded to main.

Taper Sections: 1" change in diameter to every 5" in length.

Dampers: Volume dampers in PVC ductwork shall be as constructed by ductwork supplier of same material as ductwork. Dampers shall be provided with stainless steel locknuts or similar corrosion proof attachments suitable for permanently setting dampers in a fixed position following balance and adjustment. Shaft end opposite handle must be sealed and capped. Dampers shall be provided at all branches to permit system flow balancing.

Access: Provide 12" x 12" access openings, and end caps where needed to permit system maintenance. Access openings and end caps shall conform with Figure 1-25 of the SMACNA Thermoplastic Duct (PVC) Construction Manual.

C. Hangers and Supports:

1. Ducts shall be supported at intervals not exceeding 8'0" on center. In locations where hangers are exposed to corrosive atmosphere adjacent to hoods, tanks or other process equipment, hanger material shall be epoxy coated, mild steel, with bolts, washers and other attaching hardware fabricated from Type 304 or 316 stainless steel.

2. Hangers shall be securely fastened to avoid vibration and care shall be taken to install hangers so as to avoid creating conditions of stress in the finished installation.

D. Flexible Connections:

1. Flexible connections shall be furnished and installed in accordance with this Specification at equipment locations and at expansion joints where necessary.

2. Flexible connections shall be fabricated from flexible plasticized PVC using material not less than 1/8 inch thick. Connections shall be fabricated with the longitudinal seam lapped not less than 1-1/2 inches and fusion welded.

3. Plasticized flexible connections shall be welded to ducts or equipment collars. Where flexible connections are installed as expansion joints, a suitable support or hanger shall be provided at each end of the flexible connection. Where flexible at each connections are provided for connections to fans or equipment, a support or hanger shall be provided at the unsupported location.

4. Ductwork shall be supported independently of fans, or other equipment.

2.12 DUCTWORK ACCESSORIES

A. Duct Sleeves and Prepared Openings. All square and rectangular ducts passing through floors, ceilings, or roofs shall be installed through prepared openings. The Contractor shall be responsible for the proper size and location of sleeves and openings. Duct sleeves and prepared openings shall be provided for all duct mains and duct branches.

B. Duct sleeves shall be fabricated from 20-gauge 0.0359 inch nominal thickness, galvanized steel, unless otherwise indicated. Sleeves shall provide one inch clearance between the duct and the sleeve except at grilles, registers, and diffusers.

C. Closure collars constructed of galvanized steel not less than four inches wide shall be provided on each side of walls or floors where sleeves or prepared openings are provided except where grilles, registers, or diffusers are installed. The collar shall be installed tight against the surface, and shall fit snugly around the duct. Collars shall be fabricated from 16-gauge, 0.050 inch nominal thickness, aluminum sheet.

2.13 DIFFUSERS

A. Diffusers shall be round or rectangular, as indicated, with all exposed edges rolled or otherwise stiffened and rounded. All internal parts of each diffuser, including the volume regulator and equalizing deflector shall be removable to permit cleaning of the diffuser and provide access to the duct. Removal of parts, including internal assemblies, shall be accomplished without using special tools or disturbing air distribution pattern. Round diffusers shall be Type RA-1 Krueger or equal by Titus. Square diffusers shall be SH Series by Krueger or equal by Titus.

B. Each diffuser shall be provided with a factory fabricated volume regulator (damper). The regulator shall be of the opposed-blade, gang-operated type, with removable key. The design shall be such that the air distribution pattern is not affected when the damper is closed to absorb excess pressure up to 1/4 inch w.g. The regulator shall be supplied by the diffuser manufacturer.

C. Factory fabricated devices (equalizing deflectors and extractors) furnished by the diffuser manufacturer shall be fitted at each duct take-off (collar) to provide uniform velocity across each diffuser inlet served. If only one diffuser is served by a branch, the device may be of the collar installed type. Devices shall be installed so that they can be removed through the diffuser for access to the duct. Device shall be adjustable from outside the duct (or collar) unless internal adjustment is less than 18 inches from diffuser inlet served.

2.14 FLEXIBLE CONNECTIONS:

A. Flexible connections shall be provided between fans and ducts or casings, where shown on drawings, where required to accommodate expansion of long ducts, and where required to isolate vibrating equipment.

B. Material shall be close woven glass cloth, double neoprene coated, minimum weight 28 ounces per square yard.

C. Flexible connections shall be not more than 4 inches long active length, and shall be installed with minimum two inches slack to prevent transmission of vibration. Circular connections shall be secured to fans and ducts with No. 12 MS gage metal draw bands, one inch wide. Rectangular connections shall be secured to ducts and fans with one inch by 1/8-inch flat bars fastened with screws or bolts at 8 inch intervals. Flexible material of connections shall not be painted. Metal parts of connections shall be the same as specified for connected apparatus.

2.15 TOOLS

Manufacturer shall provide a complete set of all special tools which may be necessary for adjustment, operation, and maintenance of all types of equipment furnished. Tools shall be high grade, smooth, forged, alloy tool steel. Tools shall be packed in suitable weathertight containers.

2.16 SHIPMENT

A. All portions of the equipment shall be shop assembled to the greatest extent possible to minimize field erection taking cognizance of transportation limitations.

B. The manufacturer shall submit general installation procedures for complete installation.

C. A durable shipping tag shall be securely attached to each package shipped and shall be plainly marked with the mark number corresponding to the installation instructions.

3. EXECUTION

3.01 INSTALLATION

A. Equipment and materials shall be adequately protected and carefully handled to prevent damage before and during installation. Damaged or defective items shall be replaced by Contractor.

B. All equipment shall be installed in accordance with the installation instructions furnished by the manufacturer and shall be installed by workmen thoroughly experienced in installation of such equipment. All piping connected to equipment shall be supported independently and no external loads of any type shall be placed on them.

C. Installation of piping shall be in accordance with Section 15400.

D. Electrical installation shall be in accordance with Section 16400.

E. Assemble and install ductwork in accordance with Industrial Ventilation, 19th Edition, and with SMACNA and other recognized industry practices. Install each run with a minimum of joints. Align ductwork accurately at connections, with 1/8" maximum misalignment tolerance and with internal surfaces smooth.

Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct with flanges of same material as duct. Overlap opening by at least 1-1/2 inches.

Coordinate duct installations with installation of accessories, dampers, equipment, controls and other associated trades.

Support ductwork in manner complying with SMACNA manual hanging and supporting systems chapter. Supports shall be corrosion resistant type such as stainless or coated steel. Corrosion resistant banding straps are required around duct except where hangers occur at flanged connections.

Clean ductwork internally, unit-by-unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

F. Install smoke detectors in exhaust ductwork where shown on the drawings. Smoke detectors shall be provided by the fire protection subcontractor. General contractor shall coordinate trades.

3.02 INSTALLATION OF AIR HANDLING UNITS

A. General: Install air handling units where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.

B. Access: Provide access space around air handling units for service as indicated.

C. Mounting: Mount air handling units on vibration isolators, in accordance with manufacturer's instructions. Provide flexible connections to ductwork.

D. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

E. Piping Connections: Provide piping, valves, accessories, gages, supports, and flexible connectors as indicated.

3.03 FIELD SERVICE AND TESTING

A. After the equipment has been erected, the systems shall be operated for a duration of time sufficient to show that all equipment has been properly installed and aligned and that it runs free and clear of debris and obstructions and that the system is free of excessive vibration. The conduct of the test shall be by the contractor. All automatic control functions shall be demonstrated. If the performance test of the system shows deficiencies in any aspect of the requirements of this specification, the contractor shall make such system corrections, alterations, or adjustments as are necessary to meet the requirements.

B. Mechanical intake and exhaust systems shall be balanced and adjusted to obtain the CFM shown on the drawings. Testing and balancing shall be performed by a qualified testing firm in accordance with the standard requirements and procedures of the Associated Air Balance Council. A test and balance report shall be submitted to United.

END OF SECTION 15500

DIVISION 15 - MECHANICAL

SECTION 15610 - STEAM AND CONDENSATE SYSTEM

1. - GENERAL

1.01 SCOPE

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to work specified in this Section.

B. The work of this Section includes all labor, materials, and equipment required to complete the systems as herein specified, including the following:

a. New piping valves and appurtenances for steam and condensate.

b. Condensate Receiver, Pumps and Controls.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Provisions; in Section 15010.

B. Cleaning and Testing Pipe and Equipment; in Section 15051

C. Insulation; in Section 15180

D. Heating and ventilation; in Section 15600

1.03 PRODUCT STORAGE AND HANDLING

A. Receive and handle all materials with care so as not to cause damage.

B. Use proper tools, equipment and procedures to handle and lay pipe. Do not damage pipe coatings, wrappings or linings. Repair or replace damaged pipe coatings, wrappings or linings in accordance with manufacturer's instructions or as required to restore original protection.

C. Inspect all materials, upon receipt, for defects and for compliance with Specifications. Tag, stencil or otherwise

permanently identify all materials with particular care to adequately identify specialty items.

D. All piping materials to have factory applied identification (i.e. ASTM A-74).

E. Properly store all pipe, piping materials, equipment, etc., so as to prevent deterioration while in storage. Store all materials off ground or off floor. Store inside or cover all materials subject to deterioration from weather. Protect all factory applied identification.

F. Store loose materials such as fittings, gaskets, bolts, nuts, small valves, and specialties in adequate number of bins to properly separate. Protect ends of fittings, valves and pipe from weather and abuse. Properly grease all machined surfaces.

1.04 SUBMITTALS

A. Shop drawing submittals shall be in accordance with Section 01300, submittals.

2. PRODUCTS

2.01 PIPING MATERIALS

A. Piping systems shall be of the following materials:

System	Material
Condensate	Steel
Steam	Steel

B. Steam and condensate return piping shall be seamless carbon steel pipe, Schedule 40 for steam and schedule 80 for condensate, with socket weld ends up to 2 inches (branch connections at equipment may be threaded), beveled ends in size 3 inches and over, and conforming to ASTM A-53.

1. Fittings 2" and under shall be 150 lb. malleable iron, socket weld (or screwed where applicable). Fittings 3" and over shall be standard weight butt weld carbon steel as manufactured by Tube Turns or equal. Elbows shall be long radius style. Tees and fittings shall be prefabricated except Weldolet type fittings may be used where branch is less than 1/2 the size of the main. Reducers shall be eccentric.

2. Unions shall be 150 lb. black malleable iron, ground joint, brass to iron seat, screwed ends.

2.02 VALVES

A. All valves furnished under these specifications shall be product of a manufacturer who has had long experience in design of valves and whose products have proven reliable in service in similar installations over a reasonable period of years. Unless specified otherwise, all valves shall be of the same size as the line in which they are installed.

B. Valves for steam and condensate systems shall be as follows or approved equal.

1. Gate valves two inches and smaller - Jenkins Figure 47-U; 3 inch and larger - Figure 651A.

2. Check valves two inches and smaller - Jenkins Figure 92-A; 3 inches and larger - Figure 624.

C. Steam supply solenoid valves for unit heaters shall be Type "S" normally closed, full port, bronze, globe pattern as manufactured by Magnatrol. Valves shall be powered by 120V, 3P, 60 HZ.

2.03 PRESSURE GAGES

A. Pressure gages shall be equal to Ashcroft No. 1009 with 3-1/2" stainless steel case (6" case for those gages greater than eight feet above grade), bottom outlet and gage cocks. Bourden tube and socket shall be 316 stainless steel. Accuracy shall be within 1% over middle half of scale range and 1-1/2% over the balance. Provide coil siphons on steam service.

B. Scale Ranges:

Low Pressure Steam: 0 - 60 psi.

2.04 STEAM TRAPS AND STRAINERS

Steam traps shall be float and thermostatic type traps and shall be Sarco Model FT-30. Strainers for steam lines shall be Sarco Type AT or equal. Strainers shall be of a semi-steel construction conforming to ASTM 278-Class 30, threaded, with a 20-mesh stainless steel screen.

2.05 CONDENSATE PUMPS:

Hoffman Type 302 HC Condensate Pump and cast iron receiver, duplex, having a capacity of 30 GPM and discharge pressure of 20 psig with a 36 gallon receiver capacity.

Pumps shall be of the centrifugal type with enclosed bronze impeller and stainless steel shaft. The pumps shall be so constructed that

access may be had to impeller and other interior parts without breaking pipe connections. Pumps to have mechanical seals.

The motors shall be 1 hp, 1750 rpm, three phase, dual voltage, TEFC. Factory wiring for connection to 460 volts.

The unit described herein shall be equal to the HOFFMAN Cat. No. 302 HC. The unit shall be complete with pump suction isolation valves between receiver and pumps, float switches, water level gage with shutoff valves, dial thermometers, inlet basket strainer, discharge pressure gages, mechanical alternator to sequence pumps and start second pump on high level and control panel. The control panel shall include motor starters, disconnect switches and circuit breakers, HOA switches and ON lights for each pump and control power transformer. Panel shall be complete for connection to 460 volt power source.

3. EXECUTION

3.01 PIPE AND FITTINGS

A. No defective pipe or fittings shall be used in piping systems. Any piece discovered to be defective shall be removed and replaced by a sound and satisfactory piece.

B. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from work.

C. Every pipe and fitting shall be cleaned of all debris and dirt before being used and shall be kept clean until accepted in completed work.

D. Pipe and fittings shall be accurately installed to required lines and grades. Care shall be taken to preserve a good alignment.

E. All joints shall be made in clean dry conditions and in strict accordance with manufacturer's recommendations.

3.02 INSTALLATION

A. Piping shall be installed principally as shown on the drawings. In addition, the Contractor shall provide whatever piping and fittings are necessary, whether shown on the drawings or not, for a complete and working system. Provide also vent valves at all high points,drain valves at all low points and thermal relief valves between isolable sections of piping whether shown on the drawings or not. Provide flanged connectors for all process valves, instruments and gages to facilitate removal (except those

items with less than one inch end connections may be threaded. Unions may be used for steam and condensate service).

B. Steam and condensate piping shall be installed at proper elevations with sufficient pitch. Run piping parallel to lines of building. Provide valves at all equipment. Provide drains at all low points. Provision for expansion and contraction shall be made where shown or required. Provide unions as required for removal of equipment and apparatus. Provide eccentric reducers in steam lines. Steam traps shall be provided where shown on the drawings and anywhere an isolated low point will allow condensate to collect. Drip legs shall be a minimum of 12" long and be of the same diameter as the pipe. Steam supply mains shall be sloped in the direction of flow 1/4"/10 ft. Condensate return mains shall be sloped in the direction of flow 1/4"/10 ft.

3.03 WELDED PIPE FABRICATION

A. Connect by welding, all piping, fittings, flanges, and welded-end appurtenances for service for which butt welding is indicated in the schedules of piping system materials.

B. Welding shall be performed in first class manner, to comply with all aspects including welder and procedure qualifications of ANSI code for pressure piping or with State or local code requirements which supersede it, and to the satisfaction of the Owner's representative.

C. Welds for line joints and at welding fittings shall be made by the electric arc fusion method, using welding rod of analysis to match pipe.

D. Pipe shall have mill beveled ends or machine bevel, at 37-1/2° to within 1/16" of inside wall. In isolated cases where end preparation cannot be made by machine, use oxyacetylene cutting torch to form bevels. Remove oxide and unevenness prior to welding. Welding must be continuous around pipe.

E. Groove type welding rings with knock-off spacer pins equal to Tube-Turns No. 96G shall be used for all butt welded joints. Weld must fuse with rings but not penetrate or burn through them.

F. Welds must be sound weld metal, thoroughly fused into ends of pipe and bottom of vee. Build up in excess of pipe wall to give reinforcement of 1/4 pipe wall thickness and in such manner that weld metal will increase gradually in thickness from surface of pipe to center of weld. Minimum width of weld must be at least 2-1/2 times thickness of pipe wall.

G. Fuse fillet welds for flanges and fittings into pipe or plate for

a minimum distance of 1-1/2 pipe wall thickness. Build up to present minimum throat thickness and depth of weld of 1-1/4 times pipe wall thickness.

3.04 SCREWED PIPE JOINTS

A. Screwed pipe joints shall be made with Teflon pipe thread tape approved joint compound. Joints shall be made in accordance with industry standards.

3.05 PIPE SUPPORTS AND HANGERS

A. All piping shall be supported in a substantial manner to prevent sagging and noise due to vibration. Structural members necessary or required to support, brace, or otherwise secure piping shall furnished by Contractor unless specifically noted otherwise.

B. All new pipe, two inch diameter and larger, shall be supported with suitable adjustable roller supports. Pipe less than two inches in diameter shall be secured with standard U-bolts. Roller supports and U-bolts shall be as manufactured by Fee and Mason.

C. Clevis hangers for the support of individual hanging pipes shall be Fee and Mason or equal with threaded rod and device for attachment to structural member.

D. Anchors and guides shall be provided where indicated on the drawings or where necessary to control expansion anchors and guides shall be firmly secured to masonry walls with heavy welded steel brackets. Anchors and guides shall be as manufactured by Fee and Mason.

E. Hangers for insulated piping shall be fitted with heavy gauge galvanized steel insulation saddles.

F. Channel trapeze hangers or miscellaneous fabrications shall be used where indicated on drawings or where necessary to provide adequate support spacing.

G. Hanger spacing and rod diameters shall be as follows:

Nom. Pipe Size	Support Spacing	Rod Size
3/4"	6 ft.	3/8"
1"	7 ft.	3/8"
2"	10 ft.	3/8"
3"	10 ft.	1/2"
4"	12 ft.	5/8"
6"	12 ft.	3/4"

Use double nuts on all hanger rods.

G. Finish painting of pipe supports shall be as specified in Section 09900.

3.07 CLEANING AND TESTING

A. Clean and test in accordance with Section 15051.

3.08 INSULATION

A. Insulate in accordance with Section 15180.

END OF SECTION 15610

DIVISION 16 - ELECTRICAL

SECTION 16400 - ELECTRICAL WORK

1. GENERAL

1.01 A. Drawings and General Provisions of the Contract including the General and Supplementary Conditions and applicable portions of Division 0 and Division I apply to work specified in this Section.

B. Areas bounded by Building Cols. 1-5&A-C are classified as Class I, Div. I, Group D to a level eight (8') above finished floor, El. 40.5 and 43.75.

1.02 SCOPE

A. This specification covers electrical work to be accomplished under "Contract No. 2" as noted on drawings.

B. Provide all labor, materials, equipment and services for the work shown on the drawings and/or specified herein. Electrical work is shown on Drawings E1-E5, L4 and L5.

1. Electrical service related work.

a. Extend 4-3" conduits from a point east of new CWS&T facility to electrical equipment room in CWS&T and terminate in junction box as shown on drawings.

b. Extend 4-2" conduits from a point east of new CWS&T facility to electrical equipment room in CWS&T and terminate in junction box.

2. Electrical service from an existing bus duct located in factory Building "E" to new Motor Control Center, in CWS&T facility.

3. Motor Control Center

4. Power and control wiring for equipment.

5. General overhead HID lighting including transformer, distribution panel, contactors, lighting and control wiring.

6. Transformer and distribution panel for misc. lighting, convenience outlets, and other low voltage equipment as shown on drawings.

7. Exterior lighting over doors and general area lighting along the south side of the CWS&T building.

8. Emergency and exit lighting units.

9. Fire protection system including a "Kidde Co.". KDR1000, a foam pump system including electrical service, alarm wiring and connection to an existing Kidde fire alarm system.

10. Grounding system including new CWS&T building ground loop and connection to existing factory ground grid. Factory grounding conductors run with power service.

11. Conduit, junction boxes, etc. shown on drawings for future systems.

12. Temporary power and telephone

1.03 RELATED WORK SPECIFIED ELSEWHERE

A.	Heating and Vent	15600
B.	Fire Protection	15500
C.	Overhead Doors	08331
D.	Dock Levelers and Assoc. Equip.	11161
E.	Steam and Condensate	15610

1.04 STANDARD AND CODES

The installation must comply with latest issue of NFPA70-National Electric Code, other NFPA Standards (e.g. 20, 70E, 71, 72, 77, 78, 101); OSHA, state, and municipal codes, and standards and specifications of P&W (United). All materials and equipment shall be new and the best of their respective kind and approved as suitable for the installation and use in compliance with the codes. The intent is to provide an installation that complies with or betters all code requirements.

1.05 SUBMITTALS

The electrical contractor shall make submittals of shop drawings of all electrical equipment to be used on this job per specification Section 01300 - submittals. Submittals shall show materials and details of construction, size, arrangement, performance and/or electrical characteristics, accessories, wiring diagrams and code compliances.

1.06 QUALITY

A. Used skilled workmen who are thoroughly trained and experienced in electrical work and who are familiar with the specified requirement and methods needed for proper performance of work in this Section.

B. Contractor is responsible to complete the work of this section in accordance with the requirements of listed codes and regulations of any other agencies having jurisdiction regardless of whether such materials or installations are called for elsewhere in these contract documents/drawings.

C. Equipment and component parts thereof shall bear manufacturer's name plate giving manufacturer's name, size, type, model number, serial number and electrical characteristics.

D. Material and equipment shall be essentially the standard catalogued products of manufacturer's regularly engaged in manufacture of such equipment and shall be latest design, meeting requirements of latest edition of NFPA and NEMA codes.

1.07 COORDINATION WITH CONTRACT 3 REQUIREMENTS

The work under Contract 2 shall be coordinated with the requirements of Contract 3, particularly with regard to the installation of mechanical and electrical systems. The following shall govern the work under Contract 2:

A. Maintain maximum clearance above truck pads and above future tanks to insure capability for tank removal.

B. Where so designated on drawings, allow space for routing of pipes, ducts and other facilities to be installed under Contract 3.

1.08 COORDINATION WITH MECHANICAL WORK

Electrical system layouts shall be coordination with the mechanical work as specified in Section 15010, Paragraph 1.10 C b.

2.0 MATERIALS/EQUIPMENT

2.01 GENERAL REQUIREMENTS

A. Manufacturers: Electrical material and/or equipment manufacturers shall be selected from approved manufacturers list in this Section. Material/equipment furnished shall be approved equal to that specified herein. Approved means approved by P&W (United).

B. It is the intent of this specification that the final installation shall be complete in all respects and the contractor shall be responsible for furnishing all components necessary to accomplish the functional requirements of the systems, whether or not shown on the drawings or specified herein.

2.02 CONDUIT

A. Galvanized rigid steel for all underground conduit runs and in classified areas.

B. Galvanized rigid steel or intermediate steel conduit shall be used for all above ground conduit runs except classified areas.

C. Liquid tight flexible metal conduit shall be used for connecting to motors and/or other equipment subject to vibration. Flexible metal conduit used in classified areas shall be approved for use (Class I, Div. I, Group D).

D. Minimum size conduit is 3/4" unless otherwise shown on drawings.

E. Seal fittings and other conduit fittings and junction boxes used in classified areas shall be approved for use in explosion proof areas. Compound used in seal fittings shall be of same manufacturer as the seal fitting.

2.03 WIRE

A. Power and control wiring shall be rated for 600 volt AC service and shall have standard (Class "B") soft annealed conductors with type THWN (75°C) insulation. All conductors, except fire alarm signal wiring, shall be stranded.

B. Minimum wire sizes:

Power - #12 AWG
Control - #14 AWG
Signal - #18 AWG

C. Wiring for fire alarm:

1. Alarm point wiring.
Power limited, 300 volt, 105°C,
Fire protective signaling cable,
NEC Type MPR/CMR, PVC insulated, 18 gage,
4/C Clifford, Type FAPL.

2. Control Loop Wiring.
Same as C.1. except 2/C 18 gage, Clifford,
Type FAPL-EPS.

D. Grounding: Conductors for equipment grounding shall be sized as shown on drawings and be bare copper or have insulation of green color (for equipment grounding conductors run in raceway with power conductors).

2.04 POWER FEEDER CIRCUIT BREAKER

Thermal-magnetic molded case 600 amp, 600 volt, three pole, with an interrupting rating of 35,000 amps, RMS symmetrical @ 480 volts. Circuit breaker shall be square "D", MAL 36600, in NEMA 12 enclosure Cat. No. MA1000AWK.

2.05 MOTOR CONTROL CENTER

Motor Control Center for the CWS&TF facility shall be Square "D", Class 8998, Model 5. MCC to consist of twelve (12) NEMA 12, vertical sections, each 20" wide x 20" deep x 90" high (plus mounting channel), assembled six (6) sections, back to back, with 600 amp horizontal and 300 amp vertical copper bus built to withstand 42,000 amps RMS symmetrical for use on a 480 volt, 3 phase, 3 wire system. Horizontal and vertical ground buses shall be provided with provision for connecting a 4/0 grounding conductor at each end of the completely assembled MCC.

MCC shall be provided with a 600 amp, type LH circuit breaker, 35KA IC sym. @ 480V, for top left entrance, and plug-in circuit breakers and/or combination circuit breaker, Type FH, starters as shown on the one-line diagram, Dwg. E5.

Combination CB/starter units shall be provided with control power transformers sized to operate devices as shown on wiring diagrams and schematics including motor operated dampers (louvers) for air handlers and exhaust fans. Start-stop PB's, H-O-A selector switches and indicating pilot lights shall be provided as shown on drawings. MCC shall be wired Class I, Type B.

Units of MCC, except those units labeled future, shall be identified as shown on drawings using engraved lamicord or plastic plates firmly attached (not glued) to frame. Maximum assembled shipping section shall be four (4) units. Lifting lugs shall be provided with each shipping section.

2.06 EQUIPMENT DISCONNECTS

A. Disconnects at equipment shall be heavy duty, non-fusible, safety switches or molded case switches, 480/600 volt, 3 pole, 30 amp, or 60 amp. Enclosures shall be NEMA 12, NEMA 3R or NEMA 7 as indicated on power plan, Dwg. E-1.

Square "D" - HU361 AWK; HU361RB; H60XFA

B. Combination Starters:

Individual combination starters shall be circuit breaker type with 15 amp, Type FHL, thermal-magnetic circuit breaker and Size 0 magnetic starter with control power transformer for 120VAC operation, in NEMA 4 or NEMA 7 enclosure.

- Non-Classified Area: Use Square "D", Class 8539, Cat. No. SBW2V06.
- Classified Areas: Use Square "D", Class 8539, Cat. No. SBI2V06.

C. Circuit Breakers:

Individual circuit breakers shall be thermal magnetic, Type FHL, 15 amp in NEMA 4 or NEMA 7 enclosures.

- Non-Classified Areas: Use Square "D", Class 650, Cat. No. FHL 36015 in enclosure, Cat. No. FA 100DS.
- Classified Areas: Use Square "D", Class 650, Cat. No. FHL 30615 in enclosure, Cat. No. FA 060X.

2.07 TRANSFORMERS

A. General purpose transformers provided for lighting, convenience outlets, etc. shall be 3 phase, dry type, ventilated and shall have copper windings with at least 2-2 1/2% taps, AN and 2-2 1/2% taps, BN.

B. Transformer T-1 shall have 480 volt Delta, primary winding and 480 volt WYE/277 volt secondary winding with rating of 75 KVA. Sorgel (Sq. "D") Cat. No. 75T76HCV.

C. Transformer T-2 shall have 480 volt Delta primary winding and 208V WYE/120 volt secondary winding with rating of 30 KVA. Sorgel (Sq. "D") Cat. No. 30T3HCV.

2.08 PANELBOARDS

A. Panelboards to be factory assembled with main breaker and bolt on type branch breakers, in NEMA 12 enclosures, 20" wide x 5-3/4" dp and shall have copper mains.

B. Panelboard LP1 shall be rated for 480Y/277V AC, 3 phase, 4 wire service with 225 amp mains and 110 amp main breaker, type FH (25KA IC Syn. @ 480v). Panel board shall be provided with 42 single pole spaces. Eight (8), 3 pole, and six (6), 1 pole, 30 amp branch circuit breakers, and six (6), 1 pole, 20 amp branch circuit breakers Type EHB shall be provided. Square "D" Type NEHB.

C. Panelboard LP2 shall be rated for 208Y/120V AC, 3 phase, 4 wire service with 225 amp mains and 100 amp main breaker, Type QODVH. Panelboard shall be provided with 42 single pole spaces. Branch circuit breakers, Type QODVH, shall be provided per LP2 schedule shown on drawings. Square "D" Type NQOD.

D. Lighting Contactor Panel -LCP- shall consist of six (6), with space for eight (8), 3 pole, 30 amp, 480 volt lighting contactors, with control power transformers for electrically held control. Contactors shall be suitable for use on HID ballast circuits. Contactors shall be Square "D" Class 8903, Type SM in NEMA 12 enclosure.

2.09 LIGHTING FIXTURES

A. High Intensity Discharge Lighting Fixtures

Type A - HID Highbay lighting fixture, enclosed and gasketed, 400 watt, metal halide, quick disconnect, 277 volt. Holophane EGP400MH27QDB35-F1-09162-3.

Type A, EM - same as Type A except add 250w Tungsten Halogen stand-by (re-strike) lamp.

Type B - HID Floodlight, 250 watt, high pressure sodium with photocontrol, 277 volt. Holophane, Module 600 MDWP 250 HP27 BZ-QF1-MDWPPR27.

Type C - HID floodlight, 50 watt high pressure sodium with photocontrol, Holophane WP1A050HP27BZ-F1-P

Type D - HID floodlight, 100 watt high pressure sodium with photocontrol, Holophane WL2K-100HP-27-BZ-F1-PR12.

B. Fluorescent lighting fixtures shall be equipped with energy efficient electronic ballasts.

Type E - Fluorescent lighting fixture, single 40 RS, clear acrylic, 120V, Benjamin FA2214-4R.

Type F - Fluorescent lighting fixture, 96" slimline, 2-F96T12, 120 volt. Benjamin FLB-1121-8U.

Type G - Fluorescent lighting fixture, 800MA, 2-F96T12HO, 120 volt. Benjamin FLB-1125-8U.

Type H - Fluorescent lighting fixture, recessed troffer Type, 3-40W RS, 2' x 4' or 2' x 2', parabolic, 16 or 8 cell, aluminum, louver.

2.10 EXIT LIGHTING UNITS

Single faced with no arrows, unless noted on drawings, emergency type meeting the requirements of OSHA and NFPA (70 and 100), 120/277 volt. Benjamin EXM-120-277 , Holophane HW2 CA11-R11.

2.11 EMERGENCY LIGHTING UNITS

Battery pack, wall mounted unit meeting the requirements of OSHA and NFPA (70 and 100), 12V, sealed N1-CAD, rechargeable, battery, 120/277 volt operation. Provide with time delay off relay. Units to have two (2) attached 18 watt lamps. Holophane EC12-2A-TDR.

2.12 CONVENIENCE OUTLETS

A. Non-classified Areas - Outlets shall be 20 amp, 125 volt, duplex, straight blade, grounding type, NEMA 5-20, in NEMA 4 boxes where surface mounted. Hubbell - 5362.

B. Classified Areas - Outlets shall be 20 amp, 125 volt, single, grounding type, NEMA 5-20, in NEMA 7 enclosure, 3/4" hubs. Crouse Hinds ENR-21201.

NOTE: Owner P&W (United), may require a different manufacturer's product, consistent with the mating plugs used on portable equipment. If not, provide matching plugs for the above. Crouse Hinds ENP5201.

2.13 PB'S, SELECTOR SWITCHES

A. Non-classified Areas - Use Square D, Class 9001, Type K assembled stations, NEMA 4 enclosure, number of devices as required on drawings.

B. Classified Areas - Use Crouse Hinds, Type EFD and EDS, NEMA 7D enclosure, number of devices as shown on drawings, 3/4" hubs, dead end.

2.14 MANUAL STARTERS

A. Manual starters required for protection of 120V, fractional HP motors, interlocked with other devices (e.g. exhaust fans) that require resetting after loss of power shall be toggle type, two pole, with one melting alloy thermal overload relay with handle guard and lock off feature and red pilot light. Provide thermal unit.

Non-Classified Areas: Use Square "D", Class 2510, Type F, NEMA 4 enclosure. - Cat No. FW1.

Classified Areas: Use Same except NEMA 7 enclosure. Cat. No. FR1.

B. Those required for protection (U.V. & O.L.) of 120/208, 1 phase, fractional HP motors where manual starter is only control of device use magnetically held, push button type, two pole, with one melting alloy thermal overload relay with handle guard and lock off feature and red pilot light. Provide thermal unit.

Non-Classified Areas: Use Square "D", Class 2510, Type M, NEMA 4 enclosure. Cat. No. MBW31V02 or MBW31V03.
Classified Areas: Use Square "D", Class 2510, Type M, NEMA 7 enclosure. Cat. No. MBR21V02.

C. Manual starters required for protection (U.V. and O.L.) of 480 volt, 3 phase motors use magnetically held, push button type, 3 pole, with three melting alloy thermal overload relay with lock-off feature and red pilot light. Provide thermal units.

Non-Classified Areas: Use Square "D", Class 2510, Type M, Size M-0, NEMA 4 enclosure. Cat. No. MBW32V06.

Classified Areas: Use Square "D", Class 2510, Type M, Size M-0, NEMA 7 enclosure. Cat No. MBR22V06.

2.15 TOGGLE SWITCH

Toggle switches used for lighting control, where shown on drawings, shall be Hubbell specification grade, 20 amp, 120-277 volt:

Single pole - Cat. No. 1221
Three Way - Cat. No. 1223
Exposed switches shall have NEMA 4 enclosures.

2.16 RELAYS

Fire Alarm shut-down relays, NFR and EFR, shall be industrial control relays, open Type, 120 VAC-60 Hertz, with 4 N.O. contacts and 8 N.C. contacts SQUARE "D" Class 8501, Type X, Cat. No. XO-1200.

2.17 GROUNDING REEL

Static grounding reels shall be Hannay Model HGR50 with 50 LF of 1/8" O.D. stainless steel cable with attached grounding clamp. Reel shall be spring loaded with an adjustable guide arm. Reel shall have lug for attaching a 2/0 AWG copper grounding conductor.

2.18 APPROVED MANUFACTURER'S LIST

All equipment furnished shall be equal in grade and style to that indicated, specified or scheduled. Suggested manufacturers are listed below:

A) WIRE — Rome, Carol, General Cable, Belden, Brand Rex, Penn Central.

B) CONDUIT — National, Triangle, Republic.

C) CIRCUIT BREAKERS — Square "D", CH, AB.

D) MOTOR CONTROL CENTERS — Square "D", CH, Westinghouse.

E) EQUIPMENT DISCONNECTS — Square "D", Westinghouse.

F) TRANSFORMERS — Square "D" (Sorgel), Westinghouse, Jefferson.

G) PANELBOARDS — Square "D", Westinghouse, CH.

H) LIGHTING — Day Brite, Benjamin, Miller, Keene, Holophane, Crouse Hinds.

I) LAMPS — Sylvania, Philips.

J) EMERGENCY LIGHTS — Holophane, Benjamin, Emer-G-Lite, Dual Lite.

K) EXIT LIGHTS — Benjamin, Holophane, Dual Lite.

L) WIRING DEVICES — Hubbel, Leviton, Bryant, Crouse Hinds.

M) CONDUIT FITTINGS — Crouse Hinds, Appleton, Gedney, National.

N) PULL & JUNCTION BOXES — Crouse Hinds, Columbia, Hoffman, Hope.

O) SUPPORT CHANNELS — Kindorf, Unistrut.

P) RELAYS — SQUARE D, CH, AB.

3. EXECUTION

3.01 GENERAL

Contractor is responsible that the complete electrical installation is done in strict compliance with all applicable rules, codes and regulations whether spelled out in the contract documents or not.

A. All wiring shall be run in approved raceways except in Control Room where armored cable, Type AC, may be used.

B. All conduits and electrical equipment are to be installed level, plumb and parallel with or perpendicular to building lines.

C. Minimum wire and conduit sizes are those shown on drawings or specified elsewhere.

D. Pull and junction boxes, in general, are not shown on drawings. Contractor shall install properly sized boxes as required by code, as a minimum.

E. Overhead HID lighting fixtures utilize thru wiring quick disconnect mounting and shall not be supported by the conduit alone. In addition, fixtures shall be provided with safety chains. Lighting fixtures installed in suspended ceilings shall be supported independently of the grid supports.

F. Home run conduits shall be run in roof truss space. Pull wires shall be installed, in addition to these conductors used, in all home runs.

G. All runs of conduit passing through the fire walls at Building Col. 5 must go through pass thru sleeves provided. Contractor is responsible for proper sealing of sleeves after conduit is run and sealing those sleeves not used. Sealing is not to be confused with seals required in following paragraph "H".

H. As noted elsewhere in this specification, areas west of Building, Col. 5 (1-5) are classified as Class 1, Division 1, Group D to a height of 8' above respective finished floor elevations of 40.5' and 43.75'. Work in or adjacent to these areas shall be done in strict compliance with Article 500 of NFPA 70 (NEC). All equipment installed in these areas shall be approved for the use and installed per Article 500 whether or not specified herein or indicated on drawings.

I. Fire protection equipment and alarm wiring shall be installed in compliance with NFPA70 (NEC), 71,72, FM 5-40 and requirements of P&W (United) fire department. Note that foam system pump is considered a fire pump and governed by the requirements of NFPA 20. Fire alarm circuit shall not be combined with other wiring in the same raceway with any other circuits, except as shown on drawings, and separated from other raceways by 2'where possible. Jct. boxes used for FA shall have covers painted red. The owner, P&W (United), may require additional identification. Components shall be identified according to Owner furnished listing.

3.02 GROUNDING SYSTEM - System shall be installed basically as shown on drawings. Splices, connections to grounding rods and bonding to structural steel shall be made using exothermic welding process,

i.e., Cadweld. Equipment grounding shall be accomplished through the raceway system with an additional grounding conductor run inside raceways. In general, all raceways shall have a grounding conductor, either bare copper or insulated copper conductor colored green installed with other wiring. Size of grounding conductor shall be as shown on drawings and/or per Table 250-95 of NEC.

3.03 CONDUIT, WIRE AND EQUIPMENT IDENTIFICATION

A. Conduits shall be identified as to system, (i.e., power and/or control, instrumentation, fire alarm, PA, CCTV, etc.) at origin, at junction boxes and termination. Specify voltage.

B. Individual conductors and multiconductor cables in raceways shall be identified at origin, at junction boxes and at termination. Identification shall be consistent with identification shown on drawings and shall be consistent throughout the conductor run. Conductors terminating on terminal blocks shall be identified on each side of the terminal block. Identification to include conductor number and system to which it belongs. Shrinkable sleeves shall be used for conductor identification.

C. All electrical equipment shall be identified as to its system, specific use, voltage, circuit number and origin.

D. All panelboards shall be provided with an accurate directory specifying circuit numbers and function of each circuit. MCC's shall be identified as shown on drawings.

E. Embossed, stick-on tape shall not be used for permanent identification. Use lamicord or plastic plates firmly attached (not glued) to equipment.

3.04 TESTS

A. Before final acceptance of the work all tests dictated by standard practice and/or deemed necessary by the owner, P&W (United), or other parties having jurisdiction shall be completed to satisfaction of all parties.

END OF SECTION